

RELATIONSHIPS BETWEEN MIDDLE CHILDHOOD OUTDOOR EXPERIENCES AND AN ADULT
INDIVIDUAL'S KNOWLEDGE OF THE ENVIRONMENT

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Abstract

During the last several decades, the nature of childhood has changed. There is not much nature in it anymore. Numerous studies in environmental education, environmental psychology, and conservation psychology show that the time children spend outdoors encourages healthy physical development, enriches creativity and imagination, and enhances classroom performance. Additional research shows that people's outdoor experiences as children, and adults can lead to more positive attitudes and behavior towards the environment, along with more environmental knowledge with which to guide public policy decisions.

The overall purpose of this study was to examine the effect of middle childhood (age 6-11) outdoor experiences on an individual's current knowledge of the environment. This correlational study evaluated the following potential relationships: 1) The effect of "outdoorsiness" (defined as a fondness or enjoyment of the outdoors and related activities) on an individual's environmental knowledge; 2) The effect of gender on an individual's level of outdoorsiness; 3) The effect of setting (urban, suburban, rural, farm) on an individual's level of outdoorsiness and environmental knowledge; 4) The effect of formal [science] education on an individual's level of outdoorsiness and environmental knowledge; and 5) The effect of informal, free-choice learning on an individual's level of outdoorsiness and environmental knowledge. Outdoorsiness was measured using the Natural Experience Scale (NES), which was developed through a series of pilot surveys and field-tested in this research study.

Participants included 382 undergraduate students at the University of Kansas with no preference or bias given to declared or undeclared majors. The information from this survey was used to analyze the question of whether outdoor experiences as children are related in

some way to an adult's environmental knowledge after accounting for other factors of knowledge acquisition such as formal education, media, and free-choice learning. Though a statistically significant positive correlation was found between an individual's NES and their level of environmental knowledge as an adult, the relationship was weak ($r = .112$). One-on-one interviews also were conducted with 15 individuals selected from a random sample of the 382 participants. A post-survey focus group comprised of experts from the fields of environmental science and environmental education was also conducted to discuss results from the quantitative portion of the study and provide face validity to the questionnaire.

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Chapter One

Introduction

“Let Nature be your teacher.” – William Wordsworth

General knowledge of geography is more than simply being able to name and locate cities, states and countries. A literal translation of Geography (from the Greek “earth description”) would be “to write or describe the Earth.” Geographers study the land and its features, the inhabitants, and other physical phenomena of the Earth. Geography has sometimes been referred to as “the world discipline” or a bridge between humans and the physical sciences, and as such is commonly divided into two main branches, human geography and physical geography. In a paper by Jerome Dobson (2007), it is noted that quiz after quiz illustrates children’s “geographic ignorance” through the lack of ability to identify places on a map. However, this paints a somewhat narrow view of geography. This implies that geography simply refers to knowing the names and whereabouts of specific locations. Place-name geography, as it is sometimes called, is merely the tip of the iceberg in a field that aims to understand people and places and their interactions with the environment. For example, physical geography is the study of spatial characteristics of various natural phenomena associated with the Earth’s spheres (the atmosphere, biosphere, cryosphere, hydrosphere, and lithosphere). More generally, geography is the study of spatial distributions and interpreting what they mean. Mark Harper of Daytona Beach News referred to this as ‘the why of where’ (Harper, 2007). The late J. Rowland Illick said geography is “why people do what they do where they do it” (Dobson, 2007). Edward Fernald, retired professor of geography from Florida State

University, described geography as being like history, “if you go back to Immanuel Kant, he says that all phenomena exist in time and place. If you study those phenomena through time, it’s history. We all understand what that is. If you study those same phenomena through space, it’s geography, and people don’t understand what that is” (Harper, 2007).

This lack of understanding about geography has seen discouraging trends over the last several decades dating back to the end of World War II. Major universities such as the University of Chicago, Columbia, Harvard, and Yale all saw their geography departments dissolved from 1948 to 1988 while during this same time universities were expanding more rapidly than ever (Dobson, 2007). The deficiency of attention given to geography by institutions of higher education has now led to a trickle-down effect, where K-12 education students are learning geography as part of a social studies curriculum rather than stand-alone courses. Our nation’s current body of legislation concerning progress in the K-12 school system, embodied in No Child Left Behind (NCLB), lists geography as an essential subject, though it has not been allocated a single dollar by Congress (Education, 2001). According to the United States Department of Education, since the introduction of the ‘No Child Left Behind Act’ (NCLB) in 2002, the core academic subject of English Language Arts has received over \$11 billion, math and science have received over \$1 billion, along with history, while geography, identified as its own core academic subject in NCLB, has received zero funding. Of nine specific areas listed as core academic subjects, geography remains the only unfunded mandate from NCLB (Geographic, 2012). The understanding of geography as a core academic subject is important to this research study in environmental science due to the fact that a number of major universities house their environmental science/studies programs in the Department of Geography,

including Florida State University, George Washington University, Temple University, and The University of Iowa, to name a few.

Nature and Environmental Knowledge

Numerous studies and books (Godin, 2007; James, 1990; Louv, 2008; Sobel, 1990; Trimble & Nabhan, 1995) have been written outlining positive relationships between childhood experiences in nature and subsequent attitudes and environmental behavior as a result of these experiences. Additional studies have determined that these childhood experiences also contribute to more positive attitudes towards nature by adults, and a higher likelihood of increased outdoor participation (Asah *et al.*, 2012; Trimble & Nabhan, 1995). Other studies have focused on the formation of environmental values, along with what experiences might lead to a change in these values (Ewert *et al.*, 2005; Johnson *et al.*, 2004). Further, an entire field, conservation psychology, is dedicated to understanding the threats of environmental problems on the well-being of all inhabitants on the planet, studying the relationships between humans and the rest of nature. For this study, the working definition of nature refers to the phenomena of the physical world collectively (*i.e.* plants, animals, landscapes, etc.), as opposed to humans or human creations. Additionally, outdoor (natural) experiences are used in reference to activities and/or experiences that take place outside (structured or unstructured), including spending time outside, playing outdoors, and exploring in nature.

Relatively few studies (Bradley *et al.*, 1999; Martin, 2003) have been written about specific science content knowledge related to such childhood environmental experiences. Arcury (1990) suggested that increased knowledge about the environment was assumed to

change attitudes and behaviors towards the environment. Studies of this type traditionally used what is referred to as the knowledge, attitude, and behavior (KAB) model (Robelia & Murphy, 2012), as measured by a variety of environmental scales. The online catalog, CONPSYCHMeasures, provides resources for environmental practitioners, including forty-five environmental scales in nine different research areas related to environmental issues (Bruni, Schultz, & Saunders, 2009). None of the forty-five published scales are specific to environmental knowledge, though a number of them include some measure for the construct of environmental knowledge as outlined by the KAB. Further, while some of the scales consider environmental knowledge (Leeming *et al.*, 1995; Maloney & Ward, 1973), they are focused on how the knowledge has translated into environmental attitudes and behaviors, not how the knowledge was obtained.

Children and Nature

Richard Louv discusses in his books *Last Child in the Woods* (Louv, 2008) and *The Nature Principle* (Louv, 2012) a phenomenon he refers to as ‘nature-deficit disorder,’ a condition whereby young children, and adults, lack a certain connection to nature for a variety of reasons, most of which center around an increase in technology and multimedia engagement. Younger populations have begun to separate themselves from a ‘sense of place’ and an understanding of their local environment that was common just a few decades ago (Sanger, 1997; Sobel, 1990).

With an increasing number of environmental issues coming to the forefront of everyday conversation, this disconnection from nature is being seen more and more as a reason to

increase environmental knowledge, behaviors, and attitudes. It is difficult to have a relationship with something that is never interacted with. Likewise, it is difficult to protect and conserve something that is not known or understood. Naturalist Aldo Leopold referred to a connectedness to nature as 'land ethics,' where the individual is a member of a community of interdependent parts (Leopold, 1948). Another term, biophilia, coined by Erich Fromm in 1964, makes reference to the idea of being instinctively attracted to nature (Perkins, 2010). Biologist and author E. O. Wilson later expanded on the concept of biophilia, stating it is the "urge to affiliate with other forms of life"(Wilson, 1984). In fact, many outdoor education programs are designed around ways to enhance 'land ethics' and 'biophilia' through their activities (Ewert et al., 2005). For the purposes of this research, the terms *nature* and *environment* will be used to represent 'land ethics' and 'biophilia,' since as has been previously mentioned, the Earth deals with a number of systems, biotic and abiotic, all connected and working together.

A key component of geography and environmental science education is the relationship of people to their environment and the subsequent patterns of development on the Earth's surface (Ballantyne, 1999). Regardless of one's environment, whether it be urban, rural, or somewhere in between, children from all backgrounds seem to share the common experience of creating special places in nature (Sobel, 1993). In a qualitative study, Godin (2007) concluded urban children had more knowledge of environmentally responsible behaviors and even displayed higher levels of environmental advocacy. Independent of setting (urban, rural, etc.), this study agrees with others (Leeming *et al.*, 1995; White, 2004) that increased environmental knowledge leads to more positive environmental behaviors. This is important as one's physical environment (urban, suburban, rural, farm, etc.) can lead to varied outdoor experiences at any

age (James, 1990), typically as a result of access to unstructured 'nature' activities (Gleave, 2009). In addition to one's physical environment during middle childhood, gender has also been found to play a role in environmental knowledge, attitudes, and behaviors, as well as general experiences outdoors (Ewert *et al.*, 2005; Robelia & Murphy, 2012). A study by Marino *et al.* (2012) or pre-school-age children reported that 39% of males spent more than two hours per weekday outside, compared to 35% of females. Less time spent outdoors by females had several explanations, but mainly greater parental safety concerns for females, or perceived gender roles of males versus females (Valentine & McKendrick, 1997). Specific to environmental knowledge, the literature review by Robelia and Murphy (2012), commented that all of the 15 surveys reviewed found that women scored lower on environmental knowledge questions than men, though not necessarily significantly lower. While specific content knowledge of the environment may be higher in males, Clover (2002) argued that women do possess "profound ecological knowledge," though it might not necessarily be classified as 'scientific.'

Through outdoor experiences, children develop connections to their environment, observing and understanding how it works, and recognizing what consequences might arise from various activities (Vaske & Kobrin, 2001). Studies suggest that through these environmental encounters, children undergo personality formation and character development (Kellert, 2002). Much has been written regarding personal attitudes and behaviors toward nature as a result of childhood outdoor experiences (Robelia & Murphy, 2012). While attitudes and behavior towards nature are important, little research has been conducted around whether or not these experiences lead to a formal understanding of content knowledge in the area of physical geography and the environment.

Purpose of Study

The purpose of this research was to examine the effect of middle childhood (age 6-11) outdoor experiences on an individual's current knowledge of the environment. Specific objectives of this study included: 1) determining the effect of childhood outdoor experiences on an individual's level of nature connectedness (outdoorsiness); determining the effect of outdoorsiness on an individual's environmental knowledge; 2) determining the effect of gender on an individual's level of outdoorsiness; and 3) determining the effect of setting (urban, suburban, rural, farm) on an individual's level of outdoorsiness and environmental knowledge. For the purposes of this study, outdoorsiness is defined as a fondness or enjoyment of the outdoors and related activities. Outdoorsiness was determined using a scale developed through this research, the Natural Experience Scale (NES). The higher the score on the NES, the more outdoorsy a person is considered to be. Detailed information about the development and implementation of the NES is found in the chapter *Research Methods*.

Research Hypotheses

Direct experiences in nature, those occurring as largely unplanned and unstructured events, were at the heart of this study. Kellert (2005) explained that "play in nature, particularly during the critical period of middle childhood, appears to be an especially important time for developing the capacities for creativity, problem-solving, and emotional and intellectual development." Related to the present research, a key question is, "Is outdoor play at this age also related to environmental knowledge attainment?" In this context, the following null hypotheses were tested:

H₁: There is no significant correlation between an individual's NES score for outdoorsiness and their score of environmental knowledge.

H₂: There is no significant difference in mean NES scores between males and females.

H₃: There is no significant difference in mean NES scores among individuals raised in various settings (urban, suburban, rural, and farm).

We know children can learn basic subject matter in a formal classroom setting, but are they also acquiring important knowledge about their natural world from direct experiences with nature? Some factors that have been found to contribute to acquisition of knowledge include media, formal education, and other methods of free-choice learning (Falk *et al.*, 2007; Robelia & Murphy, 2012). Free-choice learning includes, but is not limited to, personal investigations through various civic organizations and leisure pursuits, as well as visits to science centers, national parks, and local botanical gardens and arboreta (Falk *et al.*, 2007). Additionally, a deeper, more in-depth understanding of one's environment may very well lead to a deeper appreciation of it and an expanded 'sense of place' (Kudryavtsev *et al.*, 2012). As a result, a sub-objective of this study was to determine how these other factors, aside from childhood outdoor experiences, contribute to environmental knowledge using the following null hypotheses:

H₄: There is no significant difference in mean environmental knowledge scores between individuals taking more science courses and fewer science courses during formal education (high school and university).

H₅: There is no significant correlation between an individual's environmental knowledge score and their free-choice learning experiences (a subset of NES score).

Significance of Study

It is hoped that the results of this research will present valuable information on the relationship between outdoor experiences in nature during middle childhood and an adult's knowledge of the physical environment. With increasing concerns about the global environment and human impacts, this information has the potential to reshape the some of the underlying philosophies around the traditional education setting. Findings from this study may provide evidence of increased environmental knowledge through increased outdoor experiences. This could lead to recommendations for increased exposure to the natural environment in various content areas such as fine arts, social studies, and science, to name a few.

Earth is comprised of various systems working in concert with each other. Children in primary through secondary school are often taught why and how to protect their environment, though not through intentional ways to actively protect it (Blanchard, 2011). By working and playing outside, children are more likely to see and understand these connections and realize science is not merely some collection of abstract concepts to be discussed in an individual context with little to no regard for the connectedness that exists in nature (Cross, 2011). These connections are imperative; the more young children learn about becoming good stewards of the environment, the more likely they are to be more environmentally conscious as adults and throughout their lives (Blanchard, 2011).

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Chapter Two

Research Context

“There are certain pursuits which, if not wholly poetic and true, do at least suggest a nobler and finer relation to nature than we know. The keeping of bees, for instance.” – Henry David Thoreau

This chapter provides relevant information and context on the decline in childhood experiences with nature over the last quarter century. It also discusses prior research focused on the benefits of increased exposure to nature and outdoor experiences. A general review of current concerns around environmental education is addressed along with a broad discussion of the value of allowing young children to engage in the nature and process of science in both formal and informal settings.

Processes of Decision Making

Humans are naturally curious, as anyone who has watched a newborn can tell you. From birth, children utilize trial-and-error techniques to develop an understanding of their world. As children, and adults, we are constantly trying to understand situations, predict, and react to what will happen next. However, all of this knowledge and problem-solving ability does not magically appear. Everyday connections, from the formal classroom to real-world situations or problems, are not always immediately recognizable. In some cases, identification of problems by a child takes a conscious effort on the part of a parent, teacher, or mentor (Wagner, 2012). The framework for making observations and considering evidence to make the best decision possible with the information at hand, is not something regularly displayed or addressed in a

typical classroom (Meisenzahl & Moky, 2011). In order for people to make informed decisions related to scientific ideas (*e.g.* evolution, climate change, energy policy, etc.), they need to understand the nature and process of science. They need to understand that the process is worthwhile in and of itself. According to a recent study by *Understanding Science* (2014), some psychologists argue that “the way individuals learn (especially as children) bears a lot of similarity to the process of science: both involve making observations, considering evidence, testing ideas, and holding on to those that work.” Most people use their conceptions about the nature and process of science to make decisions about important personal, political, and social issues. Science as a subject is no longer just a set of abstract concepts, as is commonly taught throughout the United States today (Council, 2012).

The process of building a foundation of knowledge involves spending time reflecting on one’s surroundings by observing, gathering, recording, assembling, and synthesizing information (Gardner, 1983; Press, 2000). Wagner (2012) refers to this stage as *play*. Tools are developed to observe and measure, along with helping to analyze information and generate models. Perhaps this deeper cognitive processing could be seen as *passion*, as described by Wagner (2012). These models (visual, linguistic, etc.) are then processed and reviewed for possible errors and to compare results. There lies a possibility that this final step could lead to *purpose*, or some direction for a career or life goal (Wagner, 2012). Our perceptions are then changed based on what we learned. Clearly cognitive development and the nature of science seem to follow the same trajectory: *play, passion, and purpose*. In science education, this natural process may be referred to as inquiry (Lederman, 2009). The process is complex and must be taken in steps, beginning with simple curiosity and imagination (Tadaki *et al.*, 2011).

Looking at curiosity and imagination from a nature perspective, Richard Louv (2008) said it “is lifted from the earth itself by the muddy hand of the young; it travels along grass-stained sleeves to the heart.” With regard to play and imagination, Russian psychologist Lev Vygotsky would certainly agree (Vygotsky, 1978).

Constructivism

Well known for his work in the development of social constructivism, Vygotsky also explored the psychology of play and its role in childhood development. Through play, abstract meaning is developed separately from object meaning. For this reason, play is sometimes seen as a transitional phase from rules (*i.e.* directions or guidelines) being determined by ideas rather than by objects. Vygotsky’s famous example includes a small child wanting to ride a horse. The child is too small to ride the horse, so instead picks up a stick and pretends to ride it around. The child has created meaning separate from a specific object through the use of imagination (Vygotsky, 1978). These ideas are internalized and are used to construct a child’s understanding of the world. As children grow and develop, the process of play, imagination, and exploration may change as rules or boundaries emerge.

There are no shortage of educational philosophies that explore how learning happens and what conditions create an optimal learning environment. For the purpose of this study, and continued discussion of the nature of science, the focus is on the theory of constructivism. During the 1930s and 1940s, constructivism was a leading view among educators as part of the progressive movement in education (Cohen, 1999). While the foundations of the theory are often attributed to Jean Piaget or John Dewey, a number of other prominent psychologists,

philosophers, and educators have added to the formal understanding of constructivism (McComas *et al.*, 2002). For general discussion, constructivism is defined as a theory of how people learn, with the main idea being that knowledge cannot simply be transmitted from a teacher to a student. Instead, the student must be involved in active learning and allowed the ability to construct meaning from direct experiences. Inquiry, learning by doing, and hands-on experiences (the nature of science) are key parts of constructivist learning.

Cognitive Development

Jean Piaget laid out four distinct stages to cognitive development. In the first two years of children's lives (infancy), they learn primarily through experiences and interactions (Piaget, 1952). Also during this time, children develop object permanence (understanding that objects continue to exist even when they cannot be observed directly), and a basic understanding of time and space. Throughout life, children build on these experiences. According to Piaget (1952), there are three additional stages that follow infancy: 1) pre-operational (age 2-7), 2) concrete operational (age 7-12), and 3) formal operational (age 12+). Pre-operational development includes basic problem solving and the beginnings of organization of relationships. Somewhat logical and systematic thinking, manipulation of symbols and concrete objects, and reversible thinking are developed during the concrete operational stage. And during the formal operational stage, development includes the ability to engage in and manipulate more complex problems including hypothesis development, and the testing and reevaluation of hypotheses (Day, 1981). The nature of science is developed in much the same way.

The nature of science begins with observations and experience (Osborne & Dillon, 2010). Revisiting Piaget, in order to avoid simple repetition and instead be capable of creativity, children must construct and reinvent for themselves (Trimble & Nabhan, 1995). According to a recent study at Indiana State University (2010), “nearly half of students (49%) are bored everyday and approximately one out of every six students (17%) is bored in every class” (Yazzie-Mintz, 2010). This disengagement has long been an issue with education and has raised questions of how to overcome it. Often it has come down to a discussion of a lack of motivation on the part of the student (Winograd & Hais, 2011). But are students less motivated, or just motivated differently? A person subscribing to the constructivist theory of education would argue the latter. Those involved in more authentic learning experiences such as those outlined by constructivists are more engaged and enjoy learning more. They are involved in more problem-based explorations highlighting habits of mind, or transfer of skills, rather than strict rote memorization (Jelinek & Sun, 2003; Johnson, 2013). A main driver of student engagement is relevancy, a sense of learning being related to the real world, something that can be applied to life outside of school (Smith, 2014). In the field of geography, this is the exploration of the world outside your front door.

Increasingly in our lives we are faced with standardization. While this is not always bad, it is happening everywhere we look. This has certainly been seen in our formal education system, and the introduction and implementation of No Child Left Behind (NCLB) (Wagner, 2010). Creativity, imagination, and exploration have been given the back seat. Play is no longer based in imagination, but rather becomes guided and structured around a stringent set of rules or guidelines. Dr. Lisa Freiman, at a TEDx Talk in Richmond, VA (2014), discussed a recent

experience at a local elementary school science fair. In a setting often highlighted and seen as an optimal setting for creativity, experimentation, and learning new things, it was just the opposite. Dr. Freiman (2014) said,

“I walked into the science fair, and I was overwhelmed by the amount of information initially. Then I started to realize the display boards were prominent. All from Staples and Office Max. Everything was presented in exactly the same way. I quickly realized the science experiments were repeated. Initially I thought, how does everybody know they should turn a lemon into a battery? Soon, I admit, I started getting bored. I started realizing that all these projects were coming off the Internet, and kids were copying what they had seen when they Googled different possibilities for science fairs.”

While the basis of the preceding information is related to cognitive development and the nature of science, these processes are important for people of all ages for performing evaluations and making decisions. Problem-solving and critical thinking skills are necessary components, sometimes referred to as habits of mind, of everyday life. Individuals who understand the nature of science processes are better prepared to handle the complexities of a flattening world and become scientifically literate (Freidman, 2005; Lederman, 2009).

Science and Standards

The natural world is extremely complex. It is through the nature and processes of science that we are able to handle a variety of situations on a daily basis. These are the same processes that children use from birth to adulthood to understand common complex situations in their environments. They are the same processes scientists use day in and day out to develop solutions to local and global problems. Taking care not to diminish the importance of global concerns, the first step toward increasing geographic literacy in general is taking notice and

care of one's local environment. Learning science process skills to critically examine one's home surroundings should be of utmost importance (James, 1990; Jennings *et al.*, 2005). Facts can be learned alongside problem-solving skills, but should certainly not be the only learning that takes place. It is time that education, especially science, moves toward authentic meaningful research-based learning, where students begin with direct observations in order to generate questions about a physical location or setting. These questions will lead to the development of the skills necessary to solve ordinary problems (*i.e.* tools for measurements, techniques for analysis, etc.). Once students have sufficient practice, these skills are transferable to a wide range of everyday problems, not just science specific, and no matter how big or small.

Some examples of common problems involve understanding why certain things may be occurring in certain locations (*i.e.* why certain neighborhoods have less access to healthy foods). This is sometimes referred to as the why of where (Hartshorne, 1955). The understanding of the why and where commonly occurs during middle childhood (age 6-11), a time when children are able to take what they have learned in infancy and develop a true "love for the universe" (Trimble & Nabhan, 1995). In the context of geography, this helps children understand a true 'sense of place' (Lim & Barton, 2006). This sense of place is not necessarily specific to a geographic location. Rather, 'place' can be seen as including all the physical, biological, social, cultural, and political factors of a location (Lim & Barton, 2006). These factors provide meaning and attachment, all that is embodied by geography (Kudryavtsev *et al.*, 2012; Sanger, 1997). However, this has not always been the case.

In our current standards-based education system, the main focus has been on preparing the student population for district, state, and federal standardized assessments (Wagner, 2010). With the writing of the *K-12 Framework for Science Education (The Framework)* in 2012 by the National Research Council, a new vision was presented highlighting the integration of “understanding the ideas of science with engagement in the practices of science” (Council, 2012). Science is no longer to be a subject of rote memorization. The focus is on science and engineering practices, along with crosscutting concepts, connecting areas of science to each other, and to other subjects. The recently released *Framework* (Council, 2012) in the United States has also formulated some guidelines for understanding the nature of science.

Development of *The Framework* was the first in a two-step process, the second being to create a more coherent foundation for the development and creation of the Next Generation Science Standards (NGSS). These standards underwent a series of public reviews and were officially released in April 2013. In both documents, process skills were highlighted as a major focus of K-12 science education. The documents combined three aspects of science into a comprehensive set of performance expectations for ALL students to include aspects of each of the following dimensions: 1) scientific and engineering practices; 2) crosscutting concepts; and 3) disciplinary core ideas (Mayes & Koballa Jr., 2012). The format of the NGSS has administrators and teachers alike interested in new ways to help students meet or exceed these standards. However, regardless of format, a major challenge exists in that teachers (and administrators) may be limited by traditional assumptions about the need to master a subject area and to have all the answers (Dyment, 2005). With the writing of *The Framework*, a new vision of three-dimensional learning was presented (science and engineering practices,

crosscutting concepts, and disciplinary core ideas), highlighting the integration of “understanding the ideas of science with engagement in the practices of science” (Council, 2012).

Often practiced as memorizing names of countries, states, and capitals (*i.e.* place-name geography), the nature of geographic education has changed over the last several decades (Dobson, 2007). What used to be a discipline centered on collecting and representing physical and human facts, has shifted to one recognizing the importance of understanding “why and how, in addition to what and where” (Golledge, 2002). As such, geography education has changed as well, to help pull together these various interpretations of geography. According to the United States National Assessment Governing Board (2010):

“The purpose of geography education is to foster the development of citizens who will actively seek and systematically apply the knowledge and skills of geography in life situations. Geography education must be responsive to the abilities and needs of students and to the societal and workplace requirements of the community, the nation, and the world. Through rigorous instruction and an adaptable K–12 curriculum, geography education helps prepare students to cope with the complexities of contemporary life.”

This broad definition of geography education provides direction to helping students understand the natural world and the nature of science. From beginning to end, the integration of three-dimensional learning outlined by the NGSS is the same for all students, and provides useful repetition so that students may experience a deeper, more interdisciplinary and appreciative understanding into the nature of science through conceptual progression over time. Through the use of crosscutting relationships as outlined by the NGSS, students experience connections to other areas of science, and ultimately, other core subjects in the

typical K-12 curriculum. The expectations from these standards is that experiences will build from year to year, enabling students to make more solidified, long-term investments in their future toward potential opportunities [*purpose*] in science. Regardless of the field they choose to pursue, however, the process skills (*i.e.* problem-solving and critical thinking skills) learned through this method of cognitive development will help to ensure success in multiple facets of life.

Viewed through a broader lens, one should be interested in how the key elements of geography, through the process skills of science, might help to lead students to an enhanced or broader geographic and/or spatial understanding of their environment. Though direct solutions are not offered in NGSS, several national organizations, such as the Association of American Geographers (AAG) and the National Council for Geographic Education (NCGE), are spearheading initiatives across the United States to reduce geographic ignorance (Dobson, 2007). Examined here are two seemingly obvious methods for increasing geographic knowledge under the framework of science process skills: modeling and technology.

Geography Education

Physical geography is a unique field that encompasses other physical sciences such as meteorology, geology, biology, etc. What makes geography different is that it examines problems in each of these subject areas from a perspective of location and the relationships that exist around them (Golledge, 2002). Specific content knowledge is important, but the application of that content to a particular place is what makes geography unique.

The first steps to understanding physical and spatial relationships begin in early and middle childhood when children are allowed unstructured play time to experience their environment (Starling, 2011), and to develop knowledge of their surroundings through direct interaction and contact (Louv, 2008; Trimble & Nabhan, 1995). Nature provides a place for students to take the sometimes-abstract concepts associated with the nature of science to actually apply knowledge and build schemas “in the field.” While structured activities for the purposes of data gathering or research are necessary, more time should be allowed for the student to explore and discover on their own through increased exposure to natural environments (Ballantyne & Packer, 2002).

The lack of exposure to natural spaces has left a generation of children disconnected from nature (Andrejewski, 2011). The late Thomas Berry, Catholic priest of the Passionist order, cultural historian, and ecotheologian, once said, “the natural world is the larger sacred community to which we belong. To be alienated from this community is to become destitute in all that makes us human” (Teasdale, 1999). Once a child has been allowed to explore his or her local environment and establish a strong sense of place (*i.e.* building a fort or shelter and calling it ‘The Oak House’), additional skills and information can be assembled (Sanger, 1997). At this stage, the foundations have been properly established and the formal training in geography and spatial relationships may begin (Sanger, 1997).

Technology and Spatial Relationships

Analysis of spatial relationships may take many forms (*e.g.* paper maps, online maps, virtual globes, etc.) The use of technology and the development of technological skills may be one of the hottest topics surrounding geography education today. Geographic information systems (GIS) are generally described as computer systems designed to “capture, store, manipulate, analyze, manage, and present a wide variety of geographical data” (Foote & Lynch, 1996). GIS software programs have allowed a person to view, manipulate, and analyze large amounts of information at a single time via interactive maps where once dozens to hundreds of individual separate files may have been necessary, and likely unreasonable to obtain (Zhong *et al.*, 2009) . GIS maps have been used extensively to support spatial thinking while fostering the development of critical-thinking and analysis skills (Bodzin & Anastasio, 2006). GIS maps are and have continued to be used to help students in a variety of subject areas to understand information in a spatial or geographic context (Patterson, 2007). What makes these types of maps so powerful is their integration of various sources of information (*e.g.* remote sensing imagery, GPS waypoints, etc.) (Barnett *et al.*, 2011; Campbell, 2008). This type of technology, through the nature and processes of science, can also be expanded into non-science arenas (social welfare, environmental health, etc.).

There are a number of software programs educators and student alike may use to engage in spatial analysis. Google Earth, NASA World Wind, and ArcGIS are just a few options. One advantage a platform such as Google Earth has over other software programs like ArcGIS is the little time needed to learn the interface (Patterson, 2007). However, the level of

engagement and analysis also differs among software programs, from mere visualization to creation from field-based data. Allen (2008) offered a graphical display to illustrate the various levels of learning objectives that could be addressed with different types of visualizations (Figure 2-1).

While Figure 2-1 was framed through the context of the visualization and teaching of geomorphology concepts, the broader point of the power of GIS is clear. GIS maps are now more mainstream than ever with the rapid increase in usage of mobile devices, (*i.e.* smartphones and tablets), and most people aren't even aware of it (Esri, 2014). GIS maps are not only used to determine precise locations on a map, but can be used tell stories (*e.g.* terrain changes over time, understanding the spread of disease, business trends by region, etc.). GIS also contains analytical capabilities to determine distances to access public services, drive times of emergency vehicles, or to track environmental changes. A highlight of GIS mapping is the ability to “enhance understanding and insight to help people manage operations, make better decisions, and communicate more effectively” (Esri, 2014).

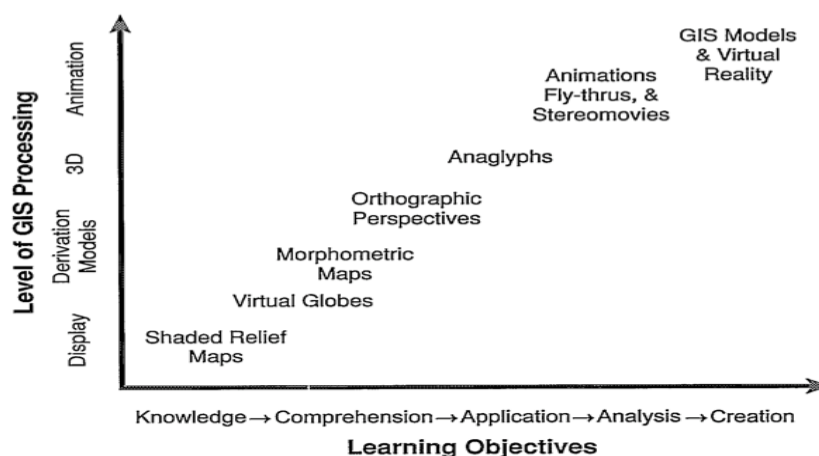


Figure 2-1 - Continuum of GIS visualization products (Allen, 2008).

Within the bounds of GIS software, geographic representation and purpose must be considered. A not unfamiliar quote by George Box tells us “all models are wrong, but some are useful” (Box, 1979). This quote may stem from the fact that models are just that, models. They generally only relate to some properties of a target (Ornek, 2008). The use of any variety of GIS software is a form of a model (Allen, 2008). Students are able to project any number of layers into the software to visualize how different variables might be related. Of course, modeling is not limited to interactive maps. Modeling can manifest itself through mathematical modeling, diagrams, physical models, etc. (Horton & Leonard, 2005; Jackson *et al.*, 2008). The breadth, importance, and benefits of modeling have been noted by national organizations and have been included in the NGSS as one of the science and engineering practices (Council, 2012). Modeling, however, just like the other practices discussed previously, does not happen all at once. Students must build on prior knowledge and experiences in order to construct models of physical phenomena, mental models, or conceptual models (Ornek, 2008). This build-up of knowledge is similar to that described by Bloom’s Taxonomy (increasing cognitive complexity over time), where the use or creation of basic maps may increase knowledge of an area, while viewing and analyzing data through geovisualization may add to comprehension and connections (Allen, 2008). The key with the use of technology as a means of visualization or modeling lies in its ability to scaffold learning to increase spatial and cognitive understanding. It is this type of scaffolding that again lies at the root of the nature of science, as students move toward higher levels of processing and synthesis of environmental and geographic concepts.

The Need for Environmental Education (A Case for Connection)

Today, children in the United States are spending less time outdoors than just a generation ago (Clements, 2004). According to Burdette and Whitaker (2005) , children are spending half as much time outdoors as they did 20 years ago. Multiple reasons can be cited for such decreased outdoor activity among children: 1) increased time spent indoors with interactive electronic media; 2) parents' fears for safety of their children; and 3) more structured and busy lifestyles for children (Mainella *et al.*, 2011; Valentine & McKendrick, 1997). This section will expand on these three reasons for decreased outdoor activity among children. It will also uncover some of the consequences related to a lack of outdoor exposure.

Electronic Media Exposure

It is no mystery that the magnitude of exposure to media outlets and electronic technology has increased dramatically in the last decade (Strasburger *et al.*, 2010). Children (age 8-18) today spend over seven hours a day on average using entertainment media (Rideout *et al.*, 2010). That is nearly fifty-three hours a week! From television to video games and social media, children today are not at a loss for excuses to avoid playing outside. Not surprisingly, some children actually prefer to remain indoors being entertained (Clements, 2004). Just as the term 'biophilia' has been used to describe a love of nature, 'videophilia' has been used to describe the love of or the desire to engage in video or media related activities or other sedentary activities rather than more active behavior (Starling, 2011). A lack of outdoor physical activity has been linked to less creativity, less self-reliance, less independence, as well as several negative health consequences (Louv, 2008).

Clements (2004) conducted a nationwide survey of 830 mothers, asking about their children's play habits. Over 95% of mothers surveyed responded that their child "watches television regularly; 81% play computer games; 61% play video games." This same study reported that 85% of surveyed mothers cited the television and video game habits of their children as the major reason for a lack of outdoor play (Clements, 2004). In another study, preschool children who spent more than two hours a day watching television also spent less than thirty minutes engaged in outdoor play compared to preschool children who spent less than two hours watching television (Burdette & Whitaker, 2005). Unfortunately, increased exposure to media outlets may also trigger another reason for the lack of outdoor play among children, parental safety concerns.

Safety Concerns

A lack of outdoor play has also been attributed to a general concern over safety (Valentine & McKendrick, 1997). Concerns over traffic near busy roads, fears of abduction by strangers (stranger danger), and general safety from gangs and random crime, have all been connected with reduced exposure to the outdoors (Valentine & McKendrick, 1997). Also noted was the fear of accidents on someone else's property leading to lawsuits (Louv, 2008). Stranger danger specifically is generally associated with the fear of what might happen should a child be allowed to be outside unsupervised. Twenty-four-hour media coverage of abductions and other violence against children has increased the parental focus on safety. Clements' (2004) survey of 830 mothers found that 61% were concerned about the lack of supervision or fear of physical harm as a reason for spending less time outdoors. She also found that 70% of the mothers

surveyed played outside daily when they were children. However, only 31% allow their children to play outside today (Clements, 2004). Interestingly enough, when children were asked about why they don't spend much time outdoors, the reason that received one of the lowest responses was the fear of crime or harm from others (Asah *et al.*, 2012). Similarly, children's own fear of getting hurt was listed as the least constraining reason for not participating in outdoor play. Of the list of options provided as possible constraints to outdoor play, Asah *et al.* (2012), "I don't have enough time" and "I have too many family obligations" topped the list.

Structured Activities

Children today are often carted from one activity to another (Mainella *et al.*, 2011). It's a soccer game in the morning and a baseball or softball game in the afternoon. During the week, there might be music rehearsal right after school followed by volleyball practice in the evening. At some point, the child is likely to have schoolwork that needs to be completed as well. When do children even have the time to play outside, unless in the structured environment of organized sports? This is not to say that structured, organized activities are not beneficial. Indeed they are (Findlay & Coplan, 2008; Mainella *et al.*, 2011). However, the structure of organized sports as they exist today has led to a 'getting better, earlier' mentality, where children are put under enormous stress to succeed at an ever-younger age.

Organized sports have seen their participation numbers increase dramatically in recent years. From 1974 to 2008, the U.S. Youth Soccer Association has seen its membership increase from 100,000 to over 3 million (Louv, 2008). While the demand for new fields is up, less and less money is being spent on open green spaces and natural parks (Louv, 2011). A possible

cause of a decrease in parks and natural spaces could be decreasing rural populations and the resulting increasing size of cities. In 1900, nearly 60% of Americans lived in rural areas or on farms, spending their time outside working, hunting, or just playing (Kimbell *et al.*, 2009). By 1970, nearly 70% of the 200 million Americans had moved to the city, and by 2008, nearly 80% of the 300 million Americans had moved away from rural communities (Kimbell *et al.*, 2009). Where there were once wild spaces, the land has now been transformed into parking lots and shopping centers. Even vacant lots that were once a childhood favorite for unstructured play are being built up or converted to non-open spaces (Louv, 2008). Louv (2008) has suggested that this lack of open space may be caused by the “criminalization of natural play.”

Once open for free use, a number of community and neighborhood parks now have exhaustive lists of rules posted (Moore, 1997). Private developments, once advertising wild spaces and open tracts of land are even closing up shop to natural play. In 2008, 47 million Americans lived in condominium neighborhoods or subdivisions with homeowner’s associations outlining strict rules against outdoor play (Louv, 2011). These rules limit activities like fishing in neighborhood ponds, skateboarding in public parking lots, and the construction of tree houses in backyards. Additionally, it is not uncommon to see “No Trespassing” or “Keep off the Grass” signs, as if “parks are only to be looked at and admired instead of romped on and enjoyed” (Clements, 2004). No wonder children are spending less time outdoors; the benefits don’t seem to outweigh the costs. Yet, free play has been shown to play a substantial role in creativity, mental health, and development of social skills (Louv, 2008; Trimble & Nabhan, 1995; White, 2004). From this, a key question arises: is it possible to be conscious of and balance the increased electronic connections and safety concerns with the known positive effects of

exposure to the outdoors? Formal means of education have tried a variety of models, as outlined in the following discussion.

Foundations of (Environmental) Education

Dating back more than 150 years, to the late 1800s, one-room schoolhouses were common all across the country. At their peak, there were more than 200,000 one-room schoolhouses in the United States (Posnick-Goodwin, 2010). There was often a single teacher who would be with the students for several years in a row, teaching the three R's (reading, writing, and arithmetic) (Education, 2014). Over time, schools consolidated and grew, enrollment increased to hundreds, even thousands, and the 'brick and mortar' system, with large multi-grade schools staffed by numerous teachers, that we know today was born.

While it can be difficult to pinpoint exact dates of significant change across the education system, there certainly were identifiable trends that led to the current organization. Generally speaking, the current structure of our schools was established in the late 1800s and early 1900s, mostly to meet the needs of an industrial economy (Board, 2010). Schools supplied factories with skilled labor, while providing literacy to the masses. The organization of the school operated on bell schedules similar to shift-time sounds in factories and were organized similar to assembly lines, segmented into years, with students being sorted by age. After years of specific coursework, testing, and moving up the line, a student would receive a diploma, with the expectation of easily finding work. However, in a post-industrial economy, with rapid globalization, unfortunately, this is not always the case.

Before delving more deeply into the discussion of the foundations of environmental education, a type of education typically grounded in authentic experiences, it is necessary to differentiate between the somewhat related terms of experiential education and experiential learning. As described by Itin (1999), these two terms have often been used interchangeably in the literature; both involve changes in judgment, knowledge, and skill as a result of direct experience. However, Itin (1999) explained that learning and education are two different constructs, and therefore, experiential learning and experiential education are also two different constructs. The biggest distinction between the two is in experiential education, where there is a “transactive component between teacher and learner which is absent from the definition of experiential learning” (Itin, 1999). Transaction implies interaction, but also an exchange, where the teacher and student both bring information to the process. With that, other terms that have been used in conjunction with experiential learning or experiential education include, but are certainly not limited to adventure education, outdoor education, action learning, problem-based learning, and reflective practice, to name just a few. Most of these tend to have a strong connection to the previously described constructivism philosophy of education. Based on this delineation, the remainder of references to experiential learning in this study will operate under the assumption of no direct or transactive component of experiential education, unless otherwise stated explicitly.

As with the previous discussion on constructivism, I will not attempt a comprehensive review of the various philosophies of experiential education. The previous clarification was necessary to initiate the discussion of the foundations of environmental education and the recent rise in popularity of such historic philosophies in education as described by Jean-Jacques

Rousseau (Realism), Maria Montessori (Reconstructionism) and Rudolf Steiner (Waldorf). The idea of environmental education is not new. Dating back to 1762 with the publication of Rousseau's *Emile*, it is argued that a teacher should have some responsibility to facilitate opportunities for students to learn about their environment (McCrea, 2006). However, as with all things, there are trends in attitudes about various ideas and philosophies.

Similarly, attitudes about the environment ebb and flow and have not always been the same. Nash (2014) provided an in-depth analysis of global attitudes toward the environment dating back several centuries. His discussion included a comparison of eastern versus western thought and their respective views on wilderness and the environment. Whereas eastern cultures viewed the man-nature relationship as "bordering on love," and "man was understood to be a part of nature," much of early western civilization saw the wilderness as "hideous and desolate" and as "an enemy to be conquered" (Nash, 2014). It wasn't until the late 1700s and early 1800s that this negative western attitude began to undergo a transformation. During this time, such environmental thinkers, philosophers, and authors as Thomas Jefferson, Alexis de Tocqueville, and Henry David Thoreau, among others, documented attitudes toward the environment and wilderness. As part of western expansion, nature was generally viewed as something to conquer, as something that stood in the way of the next push westward (Watters & Miles, 1984). By the mid-1870s into the 1890s, a variety of environmental organizations began popping up around the country and a shift in attitude toward the environment was becoming apparent (Nash, 1982). This was particularly evident in the commissioning of Yellowstone as the first national park in 1875 (Ludlow, 1985). Nature was beginning to be seen as having intrinsic value rather than something to be overcome. The election of author,

naturalist, explorer, and politician Theodore Roosevelt as President further increased the attention on protection of the environment through the establishment of 23 national parks and monuments totaling nearly 230 million acres of public land. Most of this was accomplished as part of the signing of the Act for the Preservation of American Antiquities (Antiquities Act) of 1906 (National Park Service, 2014). By the 1920s, ecology began to develop as a scientific field, presenting a view of the natural world as representing multiple, integrated parts.

Then, in the drought and record high temperatures of the 1930s, with winds topping 50 miles per hour carrying tons of dust and debris, with paint blasted off buildings, trees crushed, and the creation of sand dunes nearly 50 feet tall, the United States was forced to enter an era of conservation (Egan, 2006). In 1935, Wisconsin became the first state to require pre-service teachers to have “adequate preparation in the conservation of natural resources” (McCrea, 2006). In the 1940s, colleges began to offer degrees in conservation education, and in 1953, the Conservation Education Association was formed (McCrea, 2006). The late 1960s and early 1970s saw the passing of the National Environmental Policy Act (1969) and the National Environmental Education Act (1970), the celebration of the first Earth Day (1970), and the founding of the National Association for Environmental Education (1971), now the North American Association for Environmental Education (NAAEE). By the 1990s, there was a second National Environmental Education Act (1990), formation of the National Environmental Education and Teaching Foundation (1995), administration of the first College Board AP Environmental Science exam (1998), and publication of the *Excellence in Environmental Education: Guidelines for Learning (K-12)* (1999) by NAAEE (McCrea, 2006).

Environmental education is again making its way into the limelight. From more traditional schools with established histories such as Montessori and Waldorf, to those built around the Exploratory Learning model developed out of Outward Bound and Harvard, parents of young children are again discussing the benefits of being outdoors. Grounded in the constructivist theory of education, Montessori programs are using the outdoors as “an extension of the classroom.” Dr. Maria Montessori, for whom the schools are named, said “there must be provision for the child to have contact with nature; to understand and appreciate the order, the harmony, and the beauty in nature” (Montessori, 1986). This style of education has been found to elicit many benefits, such as more positive interactions on the playground, more advanced social cognition, more creative writing (after elementary school), a greater sense of community, and yes, better scores on standardized tests (Lillard & Else-Quest, 2006). Though Dr. Montessori makes numerous references to the benefits of nature throughout her discussion of education philosophy, specific literature on the connection of Montessori learning and environmental or outdoor education is sparse.

In similar fashion to Montessori education, Waldorf schools tend to operate through the philosophy of constructivism, with inclusion of authentic experiences in nature (Torquati *et al.*, 2013). Though these are not schools with a specific activist approach to environmentalism, the Waldorf structure as a whole places a strong emphasis on human connections to the natural world (Fehrenbacher, 2013). A central tenet of Waldorf is leaving as much as possible to a child’s imagination,” also emphasizing hands-on, play-based learning (Johnson, 2013). The idea that students who read more textbooks and have more homework achieve more is generally frowned upon in the Waldorf community. Instead, there is more attention on direct

experiences. With regard to science in particular, a study by Jelinek and Sun (2003) found the ability to apply deductive logic for students participating in a Waldorf education is at least on par with public school students, though the results were not significantly different. This is not unlike evaluation of Montessori schools. While a large population subscribes to the hands-on, direct experience philosophy, at least in connection with Waldorf and Montessori schools specifically, currently there does not appear to be a significant positive impact specific to science in comparison with current practices in public schools (Jelinek & Sun, 2003; Lillard & Else-Quest, 2006).

Through the review of literature on the different grounding philosophies (*e.g.* constructivism, idealism, etc.) of schools generally focused on outdoor and environmental education, the overarching theme was found to be a more holistic approach to education, focused on the whole child, and not science specifically. The emphasis on habits of mind, transfer of skills, and the whole child, though not straightforwardly related to science, seem to be the foundation for a number of the positive views of alternative forms of education. A direct benefit of these types of education programs and their benefits to science (environmental education) remains an area of need for future research.

While not necessarily attached to a specific philosophy of education, there are a number of school models that promote outdoor-based learning environments. Examples include Expeditionary Learning, a model based on experts from Outward Bound and Harvard; Multiple Intelligences, based on Harvard psychologist Howard Gardner (discussed later); and Open Minds through the Arts, operated through the University of Arizona (Johnson, 2013). However,

as previously mentioned, significant demonstrated positive impacts for these school models in the realm of science learning have not been consistently identified.

Green Schools (Programs)

Regardless of the type of school, Louv (2008) said, “an increasing number of parents and a few good schools are realizing the importance and the magic of providing hands-on, intimate contact between children and nature as a larger part of a child’s education.” To help spread awareness and interest in green, healthy schools, the U.S. Department of Education developed the Green Ribbon School Award in 2012. As of June 2014, there were more than a dozen recognized ‘Green Education’ organizations: Green Schools National Network, National Green Schools Society, The Coalition for Green Schools, Green Education Foundation, to name a few. It should be noted that the ‘green schools’ initiative is not limited in scope or scale to the United States.

The concept of a ‘green school’ is not necessarily centered on science or environmental education. Green schools, not unlike Waldorf or Montessori schools, are interested in ecological, pedagogical, and social transformation (Dyment & Reid, 2005). They are designed to increase physical activity, creativity, critical thinking, and citizenship (Dyment, 2005). Briefly referred to in the discussion of brick and mortar classrooms, children, parents, and educators alike are starting to understand the benefits of getting outside the classroom though this is not limited to elementary school children playing on ‘purpose/structure built playgrounds.’ The aim is to allow children (and adults) of all ages to engage in more unstructured, diverse, and creative play in nature (Tranter & Malone, 2004). For several decades, outdoor play has been

decreasing for a number of reasons (previously discussed in *The Need for Environmental Education*). However, outdoor play is crucial for the development of a child's sense of place (James, 1990; Matthews, 1995; Thompson *et al.*, 2008; Tranter & Malone, 2004). A sense of place is often used to describe characteristics that make a place special or unique for a given individual (*i.e.* a place of authentic human attachment and belonging) (Derr, 2002; Lim & Barton, 2006). It also allows for the development of a different social structure, from one based less on "physical prowess and more on a child's command of language and their creativity and inventiveness in imagining what the space might be," (Tranter & Pawson, 2001).

When children are outside, in an unstructured setting such as a park or backyard, or a more formal setting like an outdoor classroom, they are exposed to more than just a one-dimensional approach to learning. The outdoors is a place for practical exploration and can involve the study of an entire community through human impacts or ecosystem interactions, for example. The geography of the local community, mapping activities, or constructing and following a trail may be a natural combination. Or, maybe children are measuring distances between objects, finding a secret treasure on a map, or estimating and measuring the heights of trees (Bouillion & Gomez, 2001; Brown, 1998). When the context for learning shifts from a book-centered environment to one focused outdoors and on the environment, the learning becomes more meaningful (Dyment, 2005). Students see connections between education, home, the local environment, and the future. Whether it is called outdoor education, environmental education, or place-based education, the main purpose is to promote meaningful contextual experiences, the importance of which is to connect the learner to his or

her local environment. Woodhouse and Knapp (2000), when answering the question of the importance of place-based education, said,

“Education should prepare people to live and work to sustain the cultural and ecological integrity of the places they inhabit. To do this, people must have knowledge of ecological patterns, systems of causation, and the long-term effects of human actions of those patterns. One of the most compelling reasons to adopt place-based education is to provide students with the knowledge and experiences needed to actively participate in the democratic process.”

A number of colleges and universities have noticed the trend in primary and secondary schools beginning to offer environmental programs within or as an extension of the regular classroom. As a result, these colleges and universities are beginning to offer less traditional degrees in areas such as expeditionary learning and outdoor education. Deep Springs College in Deep Springs Valley, CA boasts of its “successful integration of hands-on outdoor work and rigorous academics,” through a two-year program that sends many graduates to Ivy League universities (Smith, 2014). Mary Baldwin College offers one of the nation’s first environment-based learning graduate programs, designed for educators, empowering teaching of “relevant content through engagement with the world outside your classroom walls” (College, 2014). A key point to note is that although post-secondary institutions are looking for more ways to successfully integrate environment-based learning into their curriculum offerings, it does not mean that all students participating are studying or majoring in some field directly related to environmental science. A student that attended Deep Springs College commented he had no plans to pursue a career in ranching, but there were still relevant takeaways from his education, “most notably, the ability to ask questions judiciously, and working collaboratively. Deep Springs invites you to be self sufficient in a totally different way” (Smith, 2014).

Even less traditional systems are recognizing the benefits of time spent outdoors. Urban youth programs for at-risk children are spending more time outdoors (Kudryavtsev *et al.*, 2012; Mainella *et al.*, 2011). Some courts are ordering non-violent criminal offenders to serve time volunteering in local community gardens (Bauman, 2014). And doctors are actually prescribing time outdoors as a way to reduce anxiety, stress, and foster positive attitudes to counteract depression (Louv, 2011).

As previously referenced, there have been some discouraging trends in recent years with regard to how much time children are spending outside (Burdette & Whitaker, 2005; Rideout *et al.*, 2010). These downward trends are particularly troubling when it has been shown that children who play outside are more physically active in general, more creative in their play, less aggressive, and tend to show better concentration (Burdette & Whitaker, 2005). With these precarious trends, a great deal of attention has recently been given to the benefits of outdoor play: physical health, mental health, and psychological development.

Benefits: Health and Nature

There are numerous consequences to a sedentary lifestyle (Andrejewski, 2011; Starling, 2011; Wells, 2000). In a general sense, a lack of physical activity leads to poorer health. One major effect of an inactive lifestyle is weight gain (Kimbell *et al.*, 2009) and obesity is now widely considered to be an epidemic (Malecka-Tendera & Mazur, 2006). In 1999, 13% of American children ages 6-11 and 14 % ages 12-19 were considered obese, rates that have tripled since the 1970s (Kimbell *et al.*, 2009). The alarming increase in just over 40 years has been considered by many a result of an inactive lifestyle (Federation, 2013; Starling, 2011;

Wells & Lekies, 2006). As free outdoor play declines, fitness levels also tend to decline (Mainella *et al.*, 2011). These reduced fitness levels can lead to becoming overweight, and in some cases, obese. This lack of physical activity can track from childhood and often can lead to increased risk factors for disease later in life (Pretty *et al.*, 2009). In one study, the percentage of children spending greater than two hours on outdoor play showed no differences related to weight status (Marino *et al.*, 2012). Other studies (Burdette & Whitaker, 2005) have reported an association between lower body mass index (BMI) and increased levels of outdoor play. While it is sometimes difficult to determine cause and effect, there at least seems to be a push by parents and doctors encouraging overweight children to spend more time outdoors (Lee, 2010; McCurdy *et al.*, 2010). Coupled with obesity, there appears to be a relationship between asthma and decreased exposure to the outdoors (Starling, 2011). Sherriff *et al.* (2009) reported that children, by age 11.5, were twice as likely to suffer from asthma after watching television for more than two hours daily as children who watch less.

An important connection between children's physical health and mental health can also be made. Again ignoring cause and effect, a relationship has been shown to exist linking childhood obesity to increased diagnosis of mental health disorders (*i.e.* anxiety, depression, etc.) (Kimbell *et al.*, 2009; Starling, 2011). With the busy schedules of children today, it is no wonder they feel stressed to the breaking point (Louv, 2008). The lack of outdoor play has been shown to decrease one's ability to cope with everyday stressors and increase the prevalence of emotional and psychological disorders (Mainella *et al.*, 2011). Unstructured play in nature provides the brain and body a chance to run free. Children are not confined within the walls of their homes or schools, but allowed to be imaginative and creative in a world awaiting this

interaction (Sobel, 1993). Children tend to stay engaged and conscientious when their environment is responsive. They are able to learn simultaneously with exploration and imagination, generally without interruption (Chawla, 2006).

More engaging activities can be linked to increases in concentration among children, in a society where diagnoses of attention-deficit hyperactivity disorder (ADHD) are increasing every year (Panksepp, 2007). Not only has a lack of outdoor play been linked to increases in ADHD, mainly through concomitant increases in electronic and media interactions, but increased exposure to nature has been positively linked to increased concentration in children with ADHD (Pretty *et al.*, 2009), and reduced ADHD symptoms in children across a wide range of individual and social characteristics (Kuo & Taylor, 2004). Pretty *et al.* (2009) offered a set of ten suggestions for increasing outdoor activity among children as a means to combat the physical and mental disorders previously discussed.

Shifting from physical and mental health benefits, it seems appropriate to also include discussion about nature and its effects on creativity and cognition. Recall the former discussion of the nature of science. The nature of science is grounded in the process skills of asking questions, reasoning and developing explanations from evidence, and communication of their explorations. Is it possible that in conjunction with the physical health benefits previously mentioned, children are also exercising different parts of the brain through hands-on interactions with their outdoor environment? In a story on National Public Radio (NPR), commentator John Hockenberry reported on a study revealing greater mental acuity after a walk in nature. He noted that “Albert Einstein and the mathematician and philosopher Kurt

Godel, 'two of the most brilliant people who ever walked the face of the earth, used to famously, every single day, take walks in the woods on the Princeton Campus' (Louv, 2011). Creativity, as defined by Dictionary.com, "is the ability to transcend traditional ideas, rules, patterns, relationships, or the like, and to create meaningful new ideas, forms, methods, interpretations, etc.; originality, progressiveness, or imagination." Nature inspires this creativity through visualization and full use of the senses. Kellert (2005) emphasized the importance, "during the critical period of middle childhood," for children to develop their capacities for creativity, problem-solving, and emotional and intellectual development. Louv (2011) referenced a 2006 Danish study that reported "58% of children who were in close contact with nature often invented new games; just 16% of indoor kindergarten children did." In a more recent study, Atchley *et al.* (2012) reported increased performance on a problem-solving, creativity task by 50% in a group of young adults after involvement in a 4-day wilderness expedition. Play [in nature] has also been linked to more creative and rigorous thinking in adulthood (Mainella *et al.*, 2011).

In addition to formal quantitative and qualitative studies on the effects of outdoor play, the previously referenced study by Clements (2004) surveyed a group of 830 mothers asking their opinions on the benefits of outdoor active play. The survey found 93% of mothers felt outdoor play positively impacted the development of their child's physical and motor skills, and 51% felt it positively affected the artistic and creative skills of their child. Despite some of the aforementioned reasons, parents do not allow their children to play outside unsupervised, though there at least seems to be a positive predisposition toward the creative benefits of outdoor play.

One reason for the inclusion of the discussion of creativity as a benefit for direct experiences in nature is the potential relationship with academic success. In earlier studies referenced (Eaton, 1998), the consensus on higher student achievement related to increased outdoor play was not overtly clear, though none of the studies cited negative impacts of outdoor play. Reaffirming the previous discussion on creativity and outdoor play, Coyle (2010) released the results of a study asking educators what they thought about children and the outdoors. Seventy-five percent of educators surveyed agreed with a statement that regular student engagement outdoors led to more creativity and to more effective problem-solvers in the classroom. Seventy-eight percent of the educators agreed that regular student engagement in the outdoors led to higher levels of concentration and better performance in the classroom. Additionally, students participating in nature-based programming had higher academic achievement than their peers 72% of the time (Coyle, 2010).

A 2004 study from the Pacific Education Institute's Environmental Education Assessment Project compared 77 pairs of demographically equivalent schools. Findings indicated schools with environmental education programs demonstrated higher test scores on state tests of math, reading, and writing on a consistent basis, and students exposed to environmental education tended to improve their overall GPAs. Danforth *et al.* (2008) reported significantly higher math scores in 3rd and 4th graders between a control group and a group participating in the National Wildlife Federation's *Schoolyard Habitat Program*. In a study of 338 educators from 55 schools, Powers (2004) recounted positive statistically significant correlations between participants' exposure to place-based education programming and student engagement in learning and academic achievement. Generally speaking, there appears to exist a great deal of

agreement that a positive relationship exists between outdoor play and academic achievement (Barratt & Hacking, 2011; Kellert, 2002; Malone, 2008; Sobel, 2004; Yazzie-Mintz, 2010).

However, there is a more specific question of if there exists a possible relationship with outdoor play and precise environmental knowledge.

Environmental Knowledge

As defined by the World English Dictionary, knowledge is “awareness, consciousness, or familiarity gained by experience or learning.” Per previous discussion on the foundations of education and the nature of science, debates continue about the best avenues for obtaining knowledge. However, the general stance that more [content knowledge] is better is no longer a pervasive view (Tanner, 1980; Tilbury, 1997; Zoellick *et al.*, 2012).

Knowledge is seen as a necessary component in the development of environmental attitudes and behaviors, and has also been linked to citizens’ views of environmental policy (Arcury, 1990; Bedsted & Klüwer, 2009). Maloney and Ward (1973) appear to have created the first Knowledge, Attitude, and Behavior (KAB) model for measuring environmental knowledge. Their survey consisted of twenty-four items, aimed at measuring factual knowledge of the environment. Of the three subgroups measured, members of the Sierra Club scored significantly higher ($M=16.88$, $SD=3.44$) than either college ($M=13.00$, $SD=3.51$) or non-college students ($M=10.45$, $SD=3.45$) (Maloney & Ward, 1973). In the early 1980s the Council of Environmental Quality released a national survey that included nine items assessing environmental knowledge. Only 20% of the subjects in the sample could answer at least 70% of the questions correctly (Quality, 1980). From 1997 to 2002, the National Environmental

Education Foundation (NEEF), formerly the National Environmental Education and Training Foundation (NEETF), conducted national surveys of environmental knowledge, attitudes, and behaviors. The survey knowledge questions were shaped to determine the environmental knowledge of the U.S. public, along with understanding the prevalence of environmental myths (Robelia & Murphy, 2012). A number of other states, including Kentucky, Louisiana, Nebraska, and Pennsylvania, used similar survey questions to collect state-level information on environmental knowledge to compare to the national data. Item analysis of survey questions was grouped according to various environmental categories (*e.g.* items associated with knowledge of animals). According to a review by Robelia and Murphy (2012), Americans have considerable knowledge about some environmental topics – household hazardous waste, general waste disposal, and species extinction are those topics about which Americans have the greatest knowledge. However, knowledge of such topics as energy production, water quality, and climate change appears to be lacking.

Environmental knowledge presents an interesting problem for methods of measurement. The nature of the environment as a complex system of interactions between organisms and their environment makes it difficult for the average person to develop a deep understanding of current environmental issues (Maloney & Ward, 1973). To further increase the difficulty of measuring an individual's knowledge of the environment are the various sources of knowledge acquisition: media, formal education, family traditions, etc. (Arcury, 1990; Robelia & Murphy, 2012). From these various information outlets people also tend to develop myths about the environment based on what facts and figures are presented to them and how. To understand the role of knowledge in environmental attitudes and behaviors, a

number of models have been developed (Bamberg & Möser, 2007; Heimlich & Ardoin, 2008; Kollmuss & Agyeman, 2002). These models recognize that knowledge is not solely responsible for an individual's beliefs and attitudes about the environment. However, they do illustrate knowledge as an influence on an individual's environmental beliefs and attitudes (Robelia & Murphy, 2012). Since development of a new model is beyond the scope of this current research, this study focuses only on measurement of an adult's individual knowledge of the environment.

Knowledge is clearly an important factor in determining an individual's attitudes, behaviors, and actions towards the environment; however, little research has been conducted on where or how this knowledge is acquired (Robelia & Murphy, 2012). In the not too distant past, outdoor experiences were the primary way through which children learned about their local environment (Trimble & Nabhan, 1995). They learned from their parents and grandparents how to "read" nature and the land. With recent advances in technology and a more formal approach to education, these types of experiences and passing of knowledge from generation to generation are no longer typically relied upon. There is always some technical report or forecast that will tell us what the past has been like and what changes might be anticipated for the future. More frequently, this information and understanding comes from a more structured, textbook-based setting rather than the unstructured playtime traditionally spent outdoors (Haji, 2011). As a consequence, our society has found itself at a point where this disconnect with nature has led to a reduced recognition of our dependence on, and interwoven relationship with, nature (Kellert, 2002).

If it is necessary to have knowledge of the environment in order to have more positive attitudes and behaviors about the environment, along with the ability to make better-informed environmental policy decisions, where exactly does this information come from? Several reports released from the National Wildlife Federation since 2008 indicate that increasing exposure to the outdoors has a positive effect on overall well-being, school readiness, and performance at school (Federation, 2013). Gardner (1983) released a book, *Frames of Mind: The Theory of Multiple Intelligences*, as a model challenging the long held idea of intelligence as a single entity (Gardner, 1983). Multiple intelligences, according to Gardner (1983), are similar to learning styles or methods. Early psychologists operated with the perception that general intelligence can be measured in relation to reading, writing, and arithmetic skills alone (Gardner, 1999). Gardner suggests that all individuals operate in a different frame of mind, and should not be measured by a single 'IQ' test. His initial theory included seven different intelligences: bodily-kinesthetic (body smart), musical (music smart), interpersonal (people smart), intrapersonal (self smart), linguistic (word smart), logical-mathematical (logic smart), and spatial (picture smart) (Gardner, 1983). According to the Theory of Multiple Intelligences, an individual may only excel in one, two, or three of those intelligences, and no one is likely to be good at them all. The naturalist intelligence was added in 1996, sometimes referred to as 'nature smart.' This intelligence includes the ability for one to flourish through practical hands-on experiences, generally occurring outdoors, within the environment, with nature and animals (Gardner, 1998). Individuals scoring high in the naturalist intelligence are found to learn best through their interactions with the environment, including various outdoor activities, field trips, and involvement with plants and animals. They generally are able to recognize and identify

plants, animals, clouds, rocks, and overall parts of the environment, while finding meaning in the world around them (Gardner, 2004). So what of those individuals who fall into the naturalist intelligence? They want to be outside! Famous examples of those with naturalist intelligence might include Charles Darwin, Rachel Carson, and E. O. Wilson.

Intuitively, it seems we all know children should spend more time outdoors; however, more research should be done to help empirically make the connection between outdoor experiences and better knowledge, attitudes, behaviors, and individual health. If that can be accomplished, perhaps then Richard Louv can retract his 'diagnosis' of nature-deficit disorder.

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Chapter Three

Research Methods

“Never a day passes but that I do myself the honor to commune with some of nature’s varied forms.” – George Washington Carver

This section describes the methods utilized in this study, including discussion of two pilot surveys, the survey design, sample and demographic information for the participating university, data collection and analytical strategies. Two pilot surveys were conducted to ensure survey reliability and validity. Previous research studies on environmental knowledge were also used to create reliable survey items. Detailed information on specific statistical analyses is included.

This study was organized around a three-part questionnaire survey, a series of one-on-one interviews, and a post-survey focus group. The three parts of the questionnaire included: 1) environmental knowledge assessment; 2) survey of outdoor experiences during middle childhood; and 3) demographics of the participant. The environmental knowledge assessment was composed of twenty questions adopted from a series of previous national environmental knowledge surveys, as discussed below. The survey of outdoor childhood experiences was measured by the Natural Experience Scale (NES), which contains items from a series of related research investigations on experiences in nature, also discussed below. Demographic information of the participants was collected based on a series of items adopted from the United States Census Survey (2010) and the MacArthur Network. Additional information gathered in this section included an individual’s level of formal education, and various modes of

obtaining information about the environment (e.g. free-choice learning). Together, the three sections of the questionnaire served to answer the five research objectives (stated as null hypotheses):

H₁: There is no significant correlation between an individual's NES score for outdoorsiness and a higher score of environmental knowledge.

H₂: There is no significant difference in mean NES scores between males and females.

H₃: There is no significant difference in mean NES scores among individuals raised in various settings (urban, suburban, rural, and farm).

H₄: There is no significant difference in mean environmental knowledge scores between individuals taking more science courses and fewer science courses during formal education (high school and university).

H₅: There is no significant correlation between an individual's environmental knowledge and their free-choice learning experiences (a subset of NES score).

In order to add value and richness to the quantitative data collected, individual interviews and a focus group were completed after the survey questions. The interviews were conducted from a random sampling of participants who completed the questionnaire. Information from the interviews was used to add depth to the numerical information collected via the questionnaire by obtaining more personal stories and experiences related to outdoor play during middle childhood. The focus group was comprised of experts from the fields of environmental science and environmental education. The purpose of the focus group was to

discuss the results from the quantitative portion of the study and provide face validity to the questionnaire, or whether or not the survey looked like it was measuring what it was intended to measure. A number of clarifying questions were discussed along with suggestions for possible future research.

Study Design

The design of this study was correlational and descriptive and was intended to compare the relationships between outdoorsiness and environmental knowledge with the variables of gender, environmental setting during the middle childhood years (age 6-11), and acquisition of environmental knowledge through various means (*e.g.* outdoorsiness, formal education, free-choice learning). An individual's level of outdoorsiness, as noted previously, is defined by the variety and frequency with which one participates in activities relating to, or characteristic of, the outdoors (*e.g.* camping, hiking, fishing, etc.). These activities reflect an awareness of the natural world, along with a level of wellbeing and desire to be out in nature (Nisbet *et al.*, 2009 p. 725). Within the context of education theory, Gardner (1999) suggested these types of experiences as characteristic of a Naturalist Intelligence, cited previously. This means that individuals are more in tune with nature and often interested in nurturing, exploring the environment, and learning about other species in their natural environments. Environmental knowledge was calculated by responses to a 20-question examination of environmental understanding. For reasons outlined by Robelia and Murphy (2012 p. 299), questions of environmental knowledge were adopted from previously developed national environmental knowledge surveys. Discussion of the methods used to develop the final 20-question

environmental knowledge survey and 26-item NES is described below. Fifteen follow-up interviews were completed after the conclusion of the questionnaire. The inclusion of information from these interviews provided richness to this study not attainable through strictly quantitative methods. The focus group was comprised of five, author-selected experts, in environmental science and environmental education. Both methods led to a better understanding of the complexities associated with education and human experiences in nature (Anderson, 2010).

Pilot Survey

An initial pilot survey of the general public was conducted in March 2013. The survey was conducted via Survey Monkey and was implemented through email and Facebook. The pilot survey was conducted primarily for the purposes of better understanding the nature of the survey rather than the target group of respondents. Although 71 responses were collected, this was not the ideal method for collecting data for reliability and validity testing of the initial NES instrument, as the sample groups did not match the intended population for the field study. Nevertheless, the responses provided valuable insights with regard to the survey design and the formulation of questions. Five additional participants completed the initial pilot survey in the presence of the author. The author and each of the five participants discussed the survey aloud and identified a number of areas of possible confusion or misinterpretation. A number of the original survey items were seen as somewhat misleading and involved collecting unnecessary information as it related to actual experiences in nature. This led to a more in-depth literature search that yielded already validated instruments concerned with similar

questions about outdoor experiences, attitudes, and behaviors, including difficulties with the assessing environmental knowledge. These instruments provided a foundation in developing a means to measure environmental knowledge and natural experiences.

Environmental Knowledge Items

From the initial pilot survey of environmental knowledge, twenty-five knowledge questions had a Cronbach's Alpha of 0.73, with a split-half correlation of 0.62, both seen as acceptable measures of good internal consistency (George, 2006). The mean score was 20.9 out of a possible 25, with a standard deviation of 3.01. This mean was relatively high compared with assessments from similar research (Robelia & Murphy, 2012). The high scores were likely due to the participant population having strong formal education backgrounds at the university level, especially in the sciences.

The environmental knowledge assessment in the initial pilot survey raised a number of questions that needed to be addressed before proceeding with a more in-depth study. The complex nature and connectedness of environmental issues makes the subject of environmental knowledge inherently difficult to understand (Maloney *et al.*, 1975). As a result, despite the renewed enthusiasm over environmental awareness, average people still appear to be unaware of and disconnected from the natural world around them (Leeming *et al.*, 1993). Given this situation, it is often difficult to determine an appropriate level of difficulty for environmental knowledge questions (Maloney & Ward, 1973). For this reason, environmental knowledge questions for the initial pilot survey were adopted from the National Assessment for Educational Progress (NAEP) 8th grade geography section. However, a majority of these

questions were much more geographic (place-name geography) in nature than was intended to be addressed by this study.

Seen as difficult in a number of previous research studies, the environmental knowledge questions were changed after the initial pilot survey to reflect a more consistent use of previously used environmental knowledge questions as suggested by Robelia and Murphy (2012 p. 299). The new survey contained questions from the *Children's Environmental Attitude and Knowledge Scale (CHEAKS)* (Leeming *et al.*, 1995), and national surveys (1997-2002) conducted by the *National Environmental Education and Training Foundation (NEETF)*¹. Questions were still grouped into six major categories: animals, energy, pollution, recycling, water, and general.

Natural Experience Scale (NES) Items

For the outdoor experiences portion of the survey, the initial pilot survey simply asked participants to indicate the frequency with which they participated in a variety of outdoor activities (*e.g.* ride a bike, play in creeks or streams, climb trees). In order to keep the length of the survey from being too cumbersome, the list of potential activities for participants was limited. There was the option of 'Other' where participants could include up to three additional activities that were not listed. This information was used to help make the final NES survey more meaningful and increase the likelihood of collecting more accurate information by including activities actually engaged in by pilot survey participants. Due to the limited nature of outdoor activities, the phrasing of the statements was changed from simply asking the

¹ The National Environmental Education and Training Foundation (NEETF) was renamed the National Environmental Education Foundation (NEEF) in 2007.

frequency of participation of a given activity, to more direct statements about specific outdoor activities. Additionally, the format of data collection was changed from multiple statements within a given item (matrix options) in the pilot survey to twenty-six individual statements to allow for more efficient data analysis. Formatting and organization of previous research studies, such as the Connectedness to Nature Scale (Mayer & Frantz, 2004), the Nature Relatedness Scale (Nisbet *et al.*, 2009), and the Love and Care for Nature Scale (Perkins, 2010), also led to changes in survey items between the two pilot surveys. Table 3-1 provides a specific example of how items were changed from the initial pilot survey.

Initial Pilot Survey: Where did you play and how often, between the ages of 6 and 11?					
Activity	Everyday	Once or twice a week	Once or twice a month	Less often	I can't remember
At home or my friend's home indoors					
In the streets near my home					
Woods					
Second Pilot Survey: For each of the following, please rate your level of participation in each statement on your experiences in middle childhood (age 6-11), using the scale from 1 (Never) to 5 (Almost always).					
Statement	Never	Rarely	Sometimes	Often	Almost always
When given a choice of inside or outside, I preferred to spend free-time indoors.					
My friends and I would ride our bikes around the neighborhood.					
I built tree houses or forts/dens in the woods.					

Table 3- 1 – Example NES items from the initial pilot survey and the second pilot survey.

Once the NES items were altered, an additional pilot survey was conducted in the summer of 2013 to assess the functionality of the new NES survey items. For the second pilot survey the sample population was 38 undergraduate students at the University of Texas in the UTeach Program. UTeach is a national program with the goal of increasing the number of highly qualified K-12 teachers in Science, Technology, Engineering, and Mathematics (STEM). Due to their distant location, no individual consultations were done with this second round of survey

participants. Findings from the second pilot survey of NES items resulted in the number of items being reduced before final fielding of the full NES survey. To reduce the number of items from 53 to 26, several steps were taken. Based on information and suggestions outlined by DeVellis (2011) and Wuensch (2007), items were initially removed based on visual analysis of results for normality. Those items with clearly non-normal distributions, including substantial kurtosis or skewness were removed (Wuensch, 2007). The second step relied on inter-item correlations. Four items were found to have inter-item correlation greater than .750 and were therefore removed. Additional information is described in detail in the *Results* chapter as it relates to statistical analysis of the NES. All items were constructed with a Likert scale for how frequently an individual participated in a given activity (Rarely = 1 to Almost Always = 5). The wording of some of the items warranted reverse scoring. For example, a selection of Almost Always on the item “I preferred to watch TV rather than play outside,” received the lower score (1), indicating that the individual preferred the indoor activity of watching TV to playing outside. The final survey questionnaire consisted of 26 items with the highest potential score being 130 ($5 * 26$), and the lowest being 26 ($1 * 26$).

Instruments

The two constructs examined through the final survey questionnaire were environmental knowledge and the level of outdoorsiness based on the NES. In addition to examining the relationship between environmental knowledge and the level of outdoorsiness, the study investigated the role of various predictors on environmental knowledge and the level

of outdoorsiness. In other words, which variable (outdoorsiness, formal education, or free-choice learning) is most likely to predict a higher score of environmental knowledge?

First, to measure environmental knowledge, participants completed a survey consisting of twenty factual knowledge questions to assess cognitive understanding of the environment. Reliable and validated scales – *CHEAKS* and *NEETF* – provided items used to assess environmental knowledge (Leeming *et al.*, 1995; NEETF, 2002). The items were designed with six main programmatic topic areas in mind: animals, energy, pollution, recycling, water, and general. The questions assessed knowledge of topics such as animal predation, types of energy resources, weather patterns, and water resources. All questions were in a multiple-choice format, with each question having four possible answers, yielding a probability of guessing the correct answer of 0.25. Participants were also allowed to answer ‘Don’t Know,’ according to the outline provided for the NEETF surveys (NEETF, 2002). Rationale for the inclusion of ‘Don’t Know’ as a response choice was to avoid assuming that the respondent would understand all parts of a question. For example, within science, there is no shortage of terms that individuals may or may not know. In the case of environmental knowledge, such specific concepts as surface runoff or bioaccumulation may not be part of one’s everyday communication. Further, the scope of the knowledge questions were chosen to reflect national environmental issues, so as not to bias the results of participants who were not from locations in or around the University of Kansas. No preference was given to specific questions based on geographic location (*i.e.* Midwest, Pacific Northwest, etc.) due to the sampled population potentially coming from varied locations across the country and around the world. (See Table 3-2)

Next, to measure outdoor experiences, a set of twenty-six self-reporting questions was presented to the participants asking them to reflect on their outdoor experiences and preferences of play environment in middle childhood (age 6-11). Statements dealt directly with various outdoor experiences, preferences, and their frequency. The items were adopted or adapted from previous studies of similar topics (Bixler *et al.*, 2002; Ewert *et al.*, 2005; Marketing , 2009; Nisbet *et al.*, 2009). Participants with a higher score based on greater outdoor experiences, preferences, and frequencies were associated with a higher level of natural experiences, or outdoorsiness. (See Table 3-3)

Finally, demographic information as outlined by the United States Census (2010) was also collected from participants (*e.g.* gender, ethnicity, etc.). Included in this section were three questions focusing on level of formal and informal education: involvement in nature-related organizations in the community, number of science courses completed in K-12 education and their undergraduate career, and undergraduate major. (See Figure 3-4)

The separate interview portion of the investigation consisted of nine open-ended questions related to outdoor experiences in nature as children, adapted from Natural England (2009) (See Table 3-5). These questions were directly related to those presented in the NES portion of the survey and were aimed at acquiring additional insight and context into the nature of outdoor childhood experiences. This was important in gaining a deeper, more in-depth understanding into specific experiences by individuals and how those experiences may have impacted their environmental knowledge. The intent was to gain more specific information related to an individual's experiences as they reported on the online portion of the

survey. While no connection was made between the interviewee and their responses on the survey, the comments and details helped to shed light on how individuals may have interpreted the NES items on the survey.

The focus group convened after all statistical analyses had been performed and the results section had been drafted. From this information, the focus group was provided a brief written summary of results for each of the outcome measures previously outlined, along with the survey instruments. The focus group consisted of three experts in the fields of environmental education, environmental science, and educational technology. The focus group session was conducted in a small conference room at their place of employment. The session lasted one hour.

The main goal of the focus group was to review the quantitative results and discuss possible interpretations and explanations, limitations, and future directions as they pertained to the results. To begin, the focus group members were provided a brief oral overview of the project, outcome measures, and a summary of the statistical results. The conversation then moved to overall study design and into the questionnaire survey itself. Throughout, members of the focus group asked probing questions ranging from statistical interpretations and possible areas of concern for how NES items may have been worded to the complexity and difficulty of the environmental knowledge questions. Through the course of the focus group discussion, there were no scripted questions. Additional context and remarks are discussed in chapter 5, *Summary, Discussion, and Conclusions*. A transcript of the focus group can be found in Appendix P.

Sampling Procedures

The population of interest for this study was undergraduate students from the University of Kansas (KU), with no preference or bias given to declared or undeclared majors. All students enrolled in the College of Liberal Arts and Sciences (CLAS), the school with the highest enrollment at KU, are required to complete at least one Natural Sciences and Mathematics (from the “Understanding the Natural World” category) course. Within the options for natural science courses offered at KU, the course with the largest single-course enrollment is Principles of Biology (BIOL 100). Due to the size and introductory nature of this course, it was selected for two reasons: 1) to minimize the chance that a given student was a self-identified STEM (Science, Technology, Engineering, and Math) major, and 2) to reflect the broader population of undergraduates enrolled at the university. Information obtained from the second pilot study (UTeach students from primarily STEM fields) indicated STEM majors performed significantly better on the assessment of environmental knowledge. Selecting a common course taken by a majority of undergraduate students helped to reduce any bias toward specific majors and their environmental knowledge. Ease of access to students enrolled in this course was also of particular importance. In the spring of 2014, 725 students in a single section of BIOL 100 at the University of Kansas were asked to voluntarily and anonymously complete the survey. Student did receive extra credit points in their lab section of the course. Participants were also asked to voluntarily provide contact information if they were willing to be placed into a participant pool for possible future participation in the one-on-one interviews. There were 382 responses to the initial questionnaire corresponding to a response rate of 52.7%. Again, due to the large enrollment in this class, it was expected that the sample would

be representative of the university population. One hundred fifty-nine (159) students voluntarily provided contact information for the interview portion of the study, for an opt-in rate of 41.6% of the total number of students participating in the initial survey. Initially, twenty-five volunteer participants opting in for the interview portion of this study were selected at random to answer nine additional open-ended questions related to their outdoor experiences during middle childhood. Due to a low response rate of those initially contacted, the number of participants contacted for the interview had to be expanded. In total, fifteen interviews were conducted.

The University of Kansas [Main Campus], located in Lawrence, Kansas, is situated in northeast Kansas, approximately 40 miles west of the Kansas City metropolitan area on nearly 1,000 acres. At the time of this study, total undergraduate enrollment at the University was 24,435. Males made up 50.2% of the student body, while females accounted for 49.8%. A majority of the students enrolled at the University were white (71.9%); 5.5% identified as Hispanic, 0.6% identified as American Indian/Alaskan Native, 3.7% identified as two or more races, 3.8% identified as Black, and 3.8% identified as Asian. Native Hawaiian/Pacific Islander (0.1%) and Nonresident Alien (9.2%) were two other identified race/ethnicity categories (University of Kansas, 2014).

A majority of students in attendance at the University were classified as resident (65.5%); nonresidents account for the remaining 34.5%. According to the Kansas Statistical Abstract (2012), 42.3% of students come from a family income over \$100,000. Only 6.9% of students come from family incomes less than \$24,000. To help cover or supplement the cost of

attending college, 16,216 (86.5%) undergraduates received some amount of financial aid to the tune of over \$92 million in total assistance from various loan programs. The number of students or the amount of financial support does not include sports, academic, or other scholarship or grant assistance.

Data Collection

The final version of the Environmental Knowledge and Experience Survey was administered in the spring of 2014 using Qualtrics online survey software. This format was selected for ease of data collection compared to paper-and-pencil or over-the-phone surveys (Robelia & Murphy, 2012) and for use in transferring the data to the statistical software package SPSS. The survey was open to participants for one week. The entire survey took an average of 13 minutes per respondent to complete. Interviews were completed in the two months following completion of the online survey and were conducted over the phone. Interviews lasted an average of 30 minutes and questions were asked in the order presented in Table 3-5. As questions were asked, interviewees may have been asked to provide additional details or elaboration on various aspects of a question. For example, the first question asked, “How do you think your outdoor play as a child may have affected your knowledge of the environment today?” This was commonly rephrased as, “Did you feel that you were learning about your environment during your time playing outdoors?” The rephrasing often helped interviewees better reflect on their outdoor experiences during middle childhood, allowing them to make direct connections to whether they felt like they were learning through their

experiences. Additional information and context of the interview responses is discussed in chapters 4 and 5, *Results*, and *Summary, Discussion, and Conclusions*, respectively.

Data Analysis

Before statistical analyses were performed for the five research hypotheses stated in Chapter 1, tests of reliability were completed for the environmental knowledge and the NES portions of the survey. Both constructs, environmental knowledge and NES, had adequate ($\alpha = 0.70$) to excellent ($\alpha = 0.91$) reliability, respectively (George, 2006). Both constructs together had an $\alpha = 0.88$. Below, statistical analyses associated with the five previously identified research questions are explained.

NES and Environmental Knowledge

For the purposes of determining whether a relationship existed between a person's score on the environmental knowledge assessment and their level of outdoorsiness, a correlation analysis was run on the two variables. Cohen's d values were used to demonstrate effect sizes. Cohen's d values can be used in a correlation analysis to represent the amount of variance within an experiment explained or accounted for by the model. In this instance, Cohen's d and the correlation statistic are the same.

Gender, NES, and Environmental Knowledge

An independent samples t -test was used to compare the difference in mean NES and environmental knowledge scores between males and females.

Setting, NES, and Environmental Knowledge

An ANOVA was used to compare NES and environmental knowledge scores based on an individual's home setting (urban, suburban, rural, or farm) during the middle childhood years.

Education, NES, and Environmental Knowledge

The number of science courses taken in high school and at the university level was organized into groups (*e.g.* zero, one to three, four or more). An ANOVA was used to compare the mean scores of environmental knowledge to the grouped number of science-specific courses a participant had completed in high school and at the university. Data were also collected on science courses in elementary and middle school. However, this data was not used in the analysis due to the lack of student choice found at these levels of primary and intermediate education for taking content specific courses. Students are generally required to take participate in science throughout elementary school and in each grade at the middle school level. However, students have more freedom of choice in high school and college, having the ability to enroll in additional science course above and beyond the minimal graduation requirements. Three separate analyses were conducted to compare means: 1) independent samples *t*-test for environmental knowledge and high school science courses; 2) independent samples *t*-test for environmental knowledge and university science courses; and 3) independent samples *t*-test for environmental knowledge and a combination of science courses from the two levels.

Free-choice Learning, NES, and Environmental Knowledge

It can be difficult to determine all sources of environmental knowledge, ranging from formal education to various media outlets (Robelia & Murphy, 2012). In order to determine other possible sources for obtaining environmental knowledge, items referencing free-choice learning were included as part of the NES portion of the survey. A correlation test was run to determine if there was any relationship between free-choice learning and NES scores. A separate correlation test was run to determine if any relationship existed between free-choice learning and environmental knowledge. A multiple regression analysis was then performed on NES scores, total [science] education, and free-choice learning to determine the most likely predictor of environmental knowledge scores.

Interviews and Focus Group

Information from the one-on-one interviews and the focus group are incorporated throughout the results and discussion chapters as appropriate. Transcripts from all interviews and the focus group can be found in Appendices A – P.

Table 3- 2 – Environmental knowledge survey items.

Correct Answer	Category*	Question/Answer Choices**
1. C (Maloney, 1975)	Pollution	Soil pollution is generally due to: A) Sparse rains B) Improper farming methods C) Poisonous metals D) Over-fertilization
2. A (Maloney, 1975)	Pollution	Most smog in our cities comes from: A) Automobiles B) Supersonic jets C) Industrial plants D) Landfills
3. A (Maloney, 1975)	Water	The most common pollutants of water are: A) Nitrates, phosphates B) Arsenic, silver nitrates C) Hydrocarbons D) Carbon monoxide
4. B (Maloney, 1975)	General	Ecology is best described as the study of: A) The relationship between man and the environment B) The relationship between organisms and the environment C) Pollution and its control D) The environment
5. D (Maloney, 1975)	Recycling/Waste	Which of the following materials usually takes longest to decompose? A) Tin B) Iron C) Copper D) Aluminum
6. D (Maloney, 1975)	Water	All but one of the following decompose in ocean water: A) Sewage B) Garbage C) Tin cans D) Plastic bags
7. B (Maloney, 1975)	Animals	Birds are poisoned by: A) Iron B) Mercury C) Silver D) Lead
8. B (Maloney, 1975)	General	Ecology assumes that [humans] are a(an) _____ part of nature: A) Differential B) Integral C) Inconsequential D) Superior

9. B (Leeming, 1995)	Recycling/Waste	Compared to other paper, recycled paper: A) Take more water to make B) Takes less energy to make C) Is less expensive to buy D) Produces more pollutants
10. B (NEEF, 2001)	Pollution	The most common cause of pollution of streams, rivers, and oceans is: A) Dumping of garbage by cities B) Surface water running off yards, city streets, paved lots, and farm fields C) Trash washed into the ocean from beaches D) Waste dumped by factories
11. D (Leeming, 1995)	Energy	Which is an example of a perpetual energy source? A) Nuclear B) Oil C) Wood D) Solar
12. B (NEEF, 2001)	Animals	What is the most common reason that an animal species becomes extinct? A) Pesticides are killing them B) Their habitats are being destroyed by humans C) There is too much hunting D) There are climate changes that affect them
13. A (Leeming, 1995)	Energy	Coal and petroleum are examples of: A) Fossil fuels B) Renewable sources of energy C) Recycled resources D) Alternative sources of energy
14. C (Leeming, 1995)	Water	Building a dam on a river can be harmful because it: A) Makes the river muddy B) Causes the river to flood C) Damages the river's natural ecosystem D) Increases level of pollution on the water
15. A (Leeming, 1995)	Water	Which is the most responsible for creating acid rain? A) Sulfur dioxide B) Carbon dioxide C) Ozone D) Ultraviolet radiation

16. A	General	Global CO ₂ levels are highest during what season? A) Winter B) Spring C) Summer D) Autumn
17. A (Leeming, 1995)	Energy	An example of a non-renewable resources is: A) Petroleum B) Trees C) Ocean water D) Sunlight
18. B (NEEF, 2001)	General	There are many different kinds of animals and plants, and they live in many different types of environments. What is the word used to describe this idea? A) Multiplicity. B) Biodiversity. C) Socio-economics. D) Evolution.
19. B (Leeming, 1995)	Animals	Killing animals like wolves that eat others: A) Is necessary and should be done. B) May increase the number of other animals. C) May decrease the number of other animals. D) Will help protect the environment.
20. C (Leeming, 1995)	Recycling/Waste	The main problem with landfills is that they: A) Take up too much space. B) Look and smell bad. C) Attract rats and other pests. D) Prevent farming of nearby land.

*Categories: Animals (3), Energy (3), General (4), Recycling/Waste (3), Pollution (3), Water (4)

**A fifth answer choice, 'Don't Know,' was included for each question (NEETF, 2002).

Table 3- 3 – NES survey items.

For each of the following, please rate your level of participation in each statement on your experiences in middle childhood (age 6-11), using the scale from 1 (Never) to 5 (Almost always).					
Statement	Never	Rarely	Sometimes	Often	Almost always
I spent time observing weather.					
I spent time collecting natural objects.					
I used equipment to find out more about nature.					
I took camping trips with my family or friends					
I spent time observing animals in nature.					
I spent time outdoors at night observing the planets and stars.					
I spent time digging in the earth and getting dirt on my hands.					
My ideal vacation was a remote, wilderness area.					
I spent time playing in neighborhood creeks or streams.					
I grew flowers/vegetables in a yard or garden.					
I spent time drawing, sketching, photographing, or videotaping natural phenomena.					
I took notice of wildlife wherever I was.					
I spent time hunting and/or fishing with friends/family.					
I spent time climbing trees.					
When spending time outdoors, I would use all of my senses.					
When given a choice of inside or outside, I preferred to spend free-time indoors.					
I participated in boy/girl scouts.					
I wanted to spend time outdoors.					
I participated in multi-day trips to natural areas.					
I built tree houses or forts/dens in the woods.					
I preferred to watch TV rather than play outside.					
I spent time swimming in bodies of water other than swimming pools.					

My family took trips to the zoo or botanical gardens.	
I preferred to be on the computer rather than play outside.	
I would collect animals or insects and keep them in a container for observation.	
I built or set up bird feeders, feeding stations, or home for animals.	

Figure 3- 4 – Demographic items.

Gender:	
<input type="radio"/> Male	
<input type="radio"/> Female	
Zip code where you spent a majority of your childhood (ages 6-11). (i.e. 01234)	
<input type="text"/>	
General setting of your home (based on zip code from previous question).	
<input type="radio"/> Urban (large city/core of metropolitan region)	
<input type="radio"/> Suburban (smaller municipality within metro, not the core city)	
<input type="radio"/> Rural (small town, not near metropolitan region)	
<input type="radio"/> Farm/Ranch	
General type of housing (based on zip code from previous question).	
<input type="radio"/> A mobile home	
<input type="radio"/> A one-family house detached from any other house	
<input type="radio"/> A one-family house attached to one or more houses (condo, row home)	
<input type="radio"/> A building with 2 apartments (duplex)	
<input type="radio"/> A building with 3-4 apartments	
<input type="radio"/> A building with 5+ apartments	
How many people regularly lived in your household during your childhood (age 6-11)?	
<input type="text" value="0"/>	Number of people
<input type="text" value="0"/>	Of these people, how many were children?
<input type="text" value="0"/>	Of these people, how many were adults?
<input type="text" value="0"/>	Of the adults, how many were bringing income into the household?
Race/ethnicity - How do you describe yourself? (please check the one option that best describes you)	
<input type="radio"/> American Indian or Alaska Native	<input type="radio"/> Black or African American
<input type="radio"/> Hawaiian or Other Pacific Islander	<input type="radio"/> Hispanic or Latino
<input type="radio"/> Asian or Asian American	<input type="radio"/> Non-Hispanic White

Undergraduate Major

- ☐ Science (i.e. Biology, Chemistry, Physics, Geology, Geography, etc.)
- ☐ Technology (i.e. Computer Science, Programming, etc.)
- ☐ Engineering
- ☐ Math
- ☐ Other

Level of education (father)

- ☐ High school diploma or equivalency (GED)
- ☐ Associate degree (junior college)
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Doctorate
- ☐ Professional (MD, JD, DDS, etc.)
- ☐ None of the above (less than high school)
- ☐ Other

Level of education (mother)

- ☐ High school diploma or equivalency (GED)
- ☐ Associate degree (junior college)
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Doctorate
- ☐ Professional (MD, JD, DDS, etc.)
- ☐ None of the above (less than high school)
- ☐ Other

How much science education have you had? How many courses?

	Don't Recall	Zero (0)	One to Three (1-3)	Four or more (4+)
Elementary School	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Middle School	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
High School	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How many separate Science courses have you taken in college/university (i.e. Astronomy, Biology, Chemistry, Physics, Geology, etc.)?

- ☐ Don't Recall
- ☐ Zero (0)
- ☐ One (1)
- ☐ Two to Five (2-5)
- ☐ Six to Ten (6-10)
- ☐ More than Ten (10+)

Table 3- 5 – One-on-one interview questions.

How do you think your outdoor play as a child may have affected your knowledge of the environment today?
<p><i>Follow-up to previous question:</i></p> <p>While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?</p>
Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?
Describe your level of involvement and experiences (if any) in organizations as a child (<i>i.e.</i> 4H, YMCA, Boy/Girl Scouts, etc.).
Describe your involvement (if any) in outdoor-related nature camps or programs (<i>i.e.</i> day camps, residential camps, etc.).
Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (<i>i.e.</i> natural parks, camping, fishing/hunting, climbing, etc.)?
Describe the local environment where you grew up. Did you have easy access to nature sites (<i>i.e.</i> woods, creeks/streams, open fields, etc.)?
Describe details about unstructured outdoor activities you were involved in as a child (<i>i.e.</i> if you played in the woods, in what kind of activities did you participate?).
Describe any reasons you might have had for a lack of time spent outdoors as a child (<i>i.e.</i> environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).
Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

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Chapter 4

Results

“I care to live only to entice people to look at nature’s loveliness.” – John Muir

The focus of this chapter is the quantitative results of the five research hypotheses previously discussed in the Methods chapter. This was a correlational study intended to describe a possible relationship between a person’s level of outdoorsiness during middle childhood and their environmental knowledge as an adult. Other factors that might contribute to environmental knowledge were also considered, such as formal education and free-choice learning. Data were gathered via an online, three-part questionnaire (demographics, environmental knowledge, and natural experiences scale (NES)). Scale reliability tests for both the environmental knowledge and natural experiences were calculated to analyze their internal consistency. Reliability was assessed using Cronbach’s alpha scores, a method commonly used to measure how closely related a set of items are as a group (DeVellis, 2011, p. 28). Both constructs, environmental knowledge and the NES, had adequate ($\alpha = 0.70$) to excellent ($\alpha = 0.91$) reliability, respectively (George, 2006). Environmental knowledge and NES combined for a high reliability with $\alpha = 0.88$.

The survey was administered to undergraduate students enrolled in an introductory biology course at the University of Kansas. As part of the survey, respondents were able to volunteer to participate in a post-survey interview answering open-ended questions specifically related to their outdoor experiences during middle childhood. Remarks and responses from these interviews are included throughout this chapter. Additionally, a post-survey focus group was conducted with five experts in the fields of environmental science or environmental

education. The purpose of the focus group was to discuss the results of this study and their significance, and to provide context to the various outcomes. Discussions throughout the focus group conversation raised questions of possible limitations and considerations for future research. Responses from focus group participants are included in the discussion chapter where appropriate.

The first objective of this research was the development of the Natural Experience Scale (NES). The scores from the NES were used to evaluate five outcome measures: correlation with environmental knowledge, difference of means between genders, difference of means with setting during middle childhood, correlation with level of formal education, and correlation with experiences in free-choice learning. Descriptions of the sample participants are presented first, including demographics. Reliabilities of the constructs are presented next, followed by statistical analyses of each of the five outcome measures as outlined above (also see Table 4-1).

Research (null) Hypotheses
<i>H₁: There is no significant correlation between an individual's NES score for outdoorsiness and a higher score of environmental knowledge.</i>
<i>H₂: There is no significant difference in mean NES scores between males and females.</i>
<i>H₃: There is no significant difference of NES scores among individuals raised in various settings (urban, suburban, rural, and farm).</i>
<i>H₄: There is no significant difference in mean environmental knowledge scores between individuals taking more science courses and fewer science courses during formal education (high school and university).</i>
<i>H₅: There is no significant correlation between and individual's environmental knowledge score and their free-choice learning experiences (a subset of NES score).</i>

Table 4- 1 – Table of research hypothesis statements (stated as null hypotheses) for this research study.

Participant Demographics

Seven-hundred twenty-five (725) undergraduate students at the University of Kansas were targeted to participate in this study. Of the 725 students, 382 voluntarily participated by completing the NES and Environmental Knowledge survey. This survey was conducted on a

volunteer basis and students had 10 calendar days to complete the survey on their own time. A total of 15 respondents participated in the one-on-one interview portion.

The gender of the participants included 108 (28.3%) males and 274 (71.7%) females. The interview portion of the study consisted of 3 (20%) males and 12 (80%) females. Participants were asked to describe their race by choosing from the following six demographic choices drawn from the 2010 U.S. Census: American Indian or Alaska Native, Hawaiian or Other Pacific Islander, Asian or Asian America, Black or African American, Hispanic or Latino, and Non-Hispanic White. A demographic description of the sample is presented in Table 4-2. Generally speaking, the sample was not representative of the entire student body, primarily with regard to gender.

Variable	Sample		KU Student-body	
	Percentage	N	Percentage	N
<i>Gender (n=382)</i>				
Male	28.3	108	50.2	12,276
Female	70.7	274	49.8	12,159
<i>Race/Ethnicity (n=382)</i>				
American Indian or Alaska Native	3.7	14	0.6	157
Hawaiian or Other Pacific Islander	0	0	0.1	21
Asian or Asian America	5.0	19	3.8	920
Black or African American	5.2	20	3.8	935
Hispanic or Latino	6.0	23	5.5	1,355
Non-Hispanic White	80.1	306	71.9	17,576

Table 4- 2 - Demographics of study participants (University of Kansas - <http://www2.ku.edu/~oirp/profiles/new/4-005.pdf>).

Environmental Knowledge

Environmental knowledge is something that has traditionally been very difficult to gauge and measure (Maloney *et al.*, 1975; Robelia & Murphy, 2012). Environmental knowledge for this study was measured using a combination of items adapted from the *Children's*

Environmental Attitude and Knowledge Scale (CHEAKS) and the *National Environmental Education and Training Foundation (NEETF) 2001* (Leeming *et al.*, 1995; NEETF, 2002). The two knowledge scales were combined to increase the number of items and broaden the scope of general environmental knowledge questions. The combined environmental knowledge scale consisted of twenty multiple-choice items ($\alpha = 0.70$). The items were coded as either 0 (incorrect) or 1 (correct). The answer option 'Don't Know' was coded as 0. The environmental knowledge scale was computed as a summative scale: the number of correct answers out of twenty represented each individual's environmental knowledge. To ensure the reliability of the environmental knowledge scale, Cronbach's alpha was calculated for each individual item. The removal of any one item only reduced alpha to a minimum of 0.67, still within an acceptable range. There was no increase in alpha with the removal of any single item.

In general, the results from the environmental knowledge scale ($M = 9.99$, $SD = 3.58$) highlighted some thought-provoking information (see Table 4-3). Only 59 participants, 15% of the sample ($n=382$), passed the 'test' with a 70% or higher (14 out of 20 correct responses). Of particular concern were the low scores in the areas of pollution and recycling and waste. More moderate scores were found with questions related to animals, energy, and the environment in general. The topic of water produced mixed results.

Upon further investigation, some results of environmental knowledge items induced particular concern. Just 16% of respondents answered correctly when asked about the most common soil pollutants, the lowest score on the scale. A little more than twice as many respondents, 34%, correctly identified the main components of water pollution as nitrates and

phosphates, though only 28% of respondents correctly identified the main cause of water pollution to be surface water running off yards, city streets, paved lots, and farm fields. Chemicals and fertilizers are added to farm fields and city lawns to increase production and reduce pests and weeds. In turn, these chemicals are the main source of pollution in soil and water. The biggest concern is the bioaccumulative nature of many of these pollutants (Hao *et al.*, 2005).

Of nearly equal concern was the general lack of knowledge around recycling and waste. Only 26% and 36%, respectively, of respondents answered correctly when asked which material takes the longest to decompose and what is the main problem with landfills. Despite increased recycling programs in cities across the country to reduce the need for virgin materials, there still seems to be a general lack of knowledge of the benefits of recycling. Just under half (49%) of respondents correctly answered that recycled paper takes less energy to produce than new paper.

More promising results were found in general knowledge of the environment, animals, and energy. Perhaps due to increased research on large-scale dams, along with media coverage in recent years (Moore *et al.*, 2010; Orr *et al.*, 2012; Sun *et al.*, 2012), 80% of respondents correctly identified the primary negative impact of large dams – that they damage the river’s natural ecosystem. Contrary to findings from previous studies, knowledge of biodiversity was higher in this study group, with 78% of respondents correctly defining the term from a list of four choices (NEETF, 2002). Related to this, 68% of respondents were able to identify the most common reason for species extinction. With regard to energy, respondents generally had a good idea of the differences between renewable and non-renewable energy sources.

Item Statistics (n=382)

Environmental Knowledge Items by Category	% of correct responses	Std. Deviation
Animals		
Birds are poisoned by	.41	.492
What is the most common reason that an animal species becomes extinct?	.68	.466
Killing animals like wolves that eat other animals	.59	.493
Energy		
Which is an example of a perpetual energy source?	.60	.491
Coal and petroleum are examples of	.72	.448
An example of a non-renewable resource is	.73	.447
General		
Ecology is best described as the study of	.53	.500
Ecology assumes that humans are a(an) _____ part of nature:	.43	.496
Global CO2 levels are highest during what season?	.26	.439
There are many different kinds of animals and plants, and they live in many different types of environments. What is the word used to described this idea?	.78	.416
Pollution		
The most common cause of pollution of streams, rivers, and oceans is	.28	.451
Soil pollution is generally due to	.16	.369
Most air pollution in our big cities comes from	.58	.494
Recycling/Waste		
Compared to other paper, recycled paper	.49	.501
The main problem with landfills is that they	.36	.481
Which of the following materials usually takes longest to decompose?	.26	.437
Water		
The most common pollutants of water	.34	.473
All but one of the following decompose in ocean water:	.54	.499
Building a dam on a river can be harmful because it	.80	.398
Which is most responsible for creating acid rain?	.46	.499

Table 4- 3 - Environmental knowledge questions listed by category. The percentage of correct responses is included for each item.

Natural Experience Scale (NES)

A person's connectedness to nature is something researchers have attempted to measure for many years with varying degrees of complexity and success (Leeming *et al.*, 1995; Maloney & Ward, 1973; Mayer & Frantz, 2004; Nisbet *et al.*, 2009; Perkins, 2010; Schultz, 2002). Several of these studies were interested in a person's feeling of connectedness, beliefs

about nature, and attitudes and behaviors related to nature. The principal focus of this study was on actual outdoor experiences during middle childhood. For this reason, the NES contained 26 items related specifically to experiences in nature that were adapted from previous nature scales. To ensure the reliability of the NES, Cronbach's alpha was calculated for each individual item. As with the environmental knowledge scale, there was no impact on the overall alpha with the removal of any single item.

To further evaluate the nature of the NES, a maximum likelihood principal component analysis was conducted to identify groups of inter-correlated variables to confirm the presumed underlying structure in the data of a single variable, outdoorsiness. As the factors were expected to correlate, an oblique Promax rotation was selected ($\kappa = 4$) (Nisbet *et al.*, 2009). Kappa (κ) is the stated power used for the Promax rotation; SPSS used a default value of 4 as this is generally the accepted value (Pett *et al.*, 2003; Schinka *et al.*, 2003). According to the Kaiser Criterion (eigenvalues > 1), two factors were extracted (eigenvalues – 8.27, 2.10), accounting for 39.9% of the total variance (Yong, 2013, p. 85). Catell's scree plot also suggested a two-factor model. All but three of the communality values were above 0.25. The items with communality values below 0.25 indicated that less than 25% of that item's variance was explained by either of the two factors extracted. Only one of these three variables could not be forced into either of the two factors through rules specified in SPSS. However, reliability analysis and inter-item correlations suggested that all 26 items contributed to one or both of the potential factors. Table 4-4 presents the variables ordered and grouped by loading size on the first factor. From the SPSS output, the Kaiser-Meyer-Olkin (KMO) measure of sampling

adequacy yielded a value of .918. For KMO, a value closer to 1 indicates that “patterns of correlations are relatively compact and so factor analysis should yield distinct and reliable factors” (Field, 2005, p. 6). Values above 0.9 are considered superb (Field, 2005, p. 6).

Rotated Factor Matrix ^a		
NES Items	Component	
	1	2
I spent time observing animals in nature (<i>i.e.</i> watching birds, insects, etc.).	.711	
I spent time digging in the earth and getting dirt on my hands.	.703	
I built or set up bird feeders, feeding stations, or homes for animals.	.690	
I took notice of wildlife wherever I was.	.688	
I spent time collecting natural objects (<i>i.e.</i> rocks, leaves, flowers, feathers, etc.).	.685	
I spent time outdoors at night observing the planets and stars.	.673	
I used equipment to find out more about the natural environment (<i>i.e.</i> butterfly nets, water/soil test kits, etc.).	.666	
I built tree houses or forts/dens in the woods.	.660	
I participated in multi-day trips to natural areas (<i>i.e.</i> camping/fishing trips, national parks, etc.).	.656	
I spent time observing the weather (<i>i.e.</i> clouds, storms, etc.).	.622	
My ideal vacation was a remote, wilderness area.	.622	
I spent time playing in neighborhood creeks or streams.	.614	
I would collect animals or insects and keep them in a container for observation (<i>i.e.</i> snakes, spiders, turtles, caterpillars, cocoons, etc.).	.603	
I took camping trips with my family or friends.	.575	
I spent time climbing trees.	.566	
I spent time hunting and/or fishing with friends/family.	.529	
I grew flowers/vegetables in a yard or garden.	.519	
When spending time outdoors, I would use all of my sense (<i>i.e.</i> sight, smell, taste, sound, touch).	.489	
I spent time drawing, sketching, photographing, videotaping natural phenomena.	.472	
I spent time swimming in bodies of water other than swimming pools (<i>i.e.</i> rivers, lakes, ponds, ocean).	.468	
My family took trips to the zoo or botanical gardens.	.450	
I participated in boy/girl scouts.		
I preferred to be on the computer rather than play outside.		.818
I preferred to watch TV rather than play outside.		.777
When given a choice of inside or outside, I preferred to spend free-time indoors.		.639
I wanted to spend time outdoors.	.382	-.476

Extraction Method: Maximum likelihood.

a. Rotation converged in 3 iterations.

Table 4- 4 - NES items after factor analysis.

As explained in the methodology section, the wording of some of the items warranted reverse scoring. For example, a selection of Never on the item “I preferred to watch TV rather than play outside,” received the higher score (5). This may have contributed to the identification of two unique factors, as those items that were reverse scored all loaded onto the second factor. The items loading on the first factor reflected physical experiences with the natural world. A statistical cut-off of .32 was used to determine if a specific variable loaded to a factor. Values above this cut-off (.32) are commonly considered to be statistically meaningful (Yong & Pearce, 2013). All but one variable loaded onto the two factors. “I participated in boy/girl scouts,” could not be forced into either of the two factors extracted (a component value above .32). Additionally, the results of this item also did not satisfy a normal distribution. Nearly 32% of those who responded indicated they had never participated in Scouts. Boy or girl scouts is not considered an intermittent experience, but rather a commitment over time to an organization; thus, the wording of this question compared to the other items did not lend itself to the Likert scale used for this study, possibly leading to the non-normal distribution.

Another item that came into question based on the factor analysis was “I wanted to spend time outdoors.” In general, it appeared that most respondents wanted to spend time outdoors, with only 4.7% answering Rarely or Never when asked. However, with such varied activities offered in the outdoors, it is possible that some respondents participated in activities not asked as part of the survey. Additionally, the extraction of the second factor in the factor analysis brought into question whether or not to include all 26 items. The second factor seemed to be measuring the same thing as the first, a person’s preference for the outdoors.

Higher scores (*i.e.* response of Rarely or Never) on these items were indicative of the respondent's preference for the outdoors.

Based on the concerns just discussed, additional reliability and factor analyses were performed with the removal of those items in the second factor (see Table 4-5) resulting in a modified NES. The reliability analysis of the modified NES showed an increased alpha ($\alpha = 0.92$). Also, a factor analysis and scree plot confirmed the existence of a single factor, outdoorsiness, identified by the NES, accounting for 39.4% of the total variance. The variances calculated in this study were consistent with previous research on levels of connection to nature (Mayer & Frantz, 2004; Nisbet et al., 2009). The mean of the modified NES was 56.8 ($SD=14.4$), with a minimum of 21, and a maximum of 99. The modified NES scale was used for the remainder of the research.

Items Removed
I participated in boy/girl scouts.
I preferred to be on the computer rather than play outside.
I preferred to watch TV rather than play outside.
When given a choice of inside or outside, I preferred to spend free-time indoors.

Table 4- 5 – List of items removed from the NES through the factor analysis process and excluded from statistical analyses.

Generally speaking, while there were no items that more than half of the respondents reported to participate in Often or Almost Always, there was some encouraging information that indicated respondents preferred to be outdoors. Respondents reported Rarely or Never when choosing the following activities versus spending time outside: to spend free time indoors, to watch TV, or to play on the computer, with responses of 40.1%, 35.1%, and 56.0%, respectively. A few of the more common activities respondents reported to have participated in at least sometimes included digging in the earth (68.8%), swimming in bodies of water other than pools (64.9%), observing the planets and stars (62.0%), and climbing trees (70.7%).

A major element of the interview was to uncover context associated with outdoor experiences during middle childhood. Questions were structured to engage respondents in reflection about structured and unstructured activities in which they participated. A majority of the respondents reported participating in some sort of organized outdoor sport, including softball, football, soccer, and track. One of the females even commented “Yea, I played baseball with the boys.” Others reported involvement in indoor sports such as hockey, swimming, and gymnastics. As is often common during middle childhood, many respondents reported being involved in a number of outdoor (and indoor) sports depending on the season, “I played softball in the summer. I played basketball in the winter, along with dance and gymnastics.” However, just because a sport is played indoors, doesn’t mean a person can’t practice outside: “I would practice outside in the yard when I got home. I would use outdoors as a gym. We had a little mat. I’d do back handsprings across the yard.” One respondent commented that even though they weren’t playing the sport themselves, “we would watch my brothers play [baseball]. We’d be running through the woods.”

Even though a majority of respondents participated in outdoor sports, it was clear that not all of them enjoyed being outside in less structured settings. “I did not like the outdoors very much as a child. I did play in the park and ride my bike though.” On the other hand, others very much enjoyed being outdoors – from playing in the woods, (“we loved to play in the creek near our house, and explore through the woods that were in our back yard. We would also take walks on the paths that ran through the woods in our neighborhood;”) to digging and playing in the dirt (“When I was little my best friend had a backyard and we would dig up worms and look

at different plants. He also had a birthday party where his family hid different rocks and minerals around and the ones we found we got to keep.”)

In some cases, although individuals may have chosen not to spend free time outdoors on their own, they have been part of organizations that encouraged or were built around spending time outside. Briefly mentioned previously, there was a single item on the NES portion of the survey asking respondents to indicate if they had participated in Boy or Girl Scouts. No other organizations were mentioned in items on the NES portion of the survey. For that reason, a question was included in the interview portion, with the understanding that a number of organizations often include participation in outdoor activities. Seven of the fifteen interviewees indicated they had participated in Scouts at some point during their childhood. Only two others indicated involvement in any other formal organizations (*e.g.* 4H and Indian Princesses). When asked more specifically about outdoor experiences related to involvement in these organizations, the responses were quite varied, “I had good experiences in Girl Scouts. I met a lot of friends and have a lot of memories of our campouts and things like that. My mom was my leader so she helped me have a good experience. And my family has been doing scouting for a long time.” Others had a hard time recalling the particulars of their involvement, “I don’t really remember. Mom didn’t like the person running it, and it was disorganized.” Another commented that “Girl scouts, in the troop, definitely did not focus much on outdoor. Lots of arts and crafts. It was boring.” As is common in organizations, positive experiences are oftentimes in the eye of the beholder, “I participated in Girl Scouts all of elementary school. We had a really good leader who got our troop involved in a lot of outdoor activities: horseback

riding, canoeing, camping, gardening, volunteering, etc. We also went to Girl Scout Camp in the summer.”

As a follow-up question to participation in organizations, respondents were also asked if they participated in multi-day experiences away from home, either as part of these organizations or otherwise. Of the fifteen respondents, six of them referenced experiencing some time away from home during middle childhood, generally related to some outdoor experience. One respondent said “I was in a summer camp for years and went to sleep away camps. My summer camp, camp Evergreen, did a bunch of nature hikes and Phantom Lake my sleep away camp was very focused on preserving nature.” Another had a similar recollection of an experience camping during multiple weeklong overnights, stating that there was “even a part where you got to pick which place you slept. You could stay in a cave if you wanted to. There were bunks, but only 3 sides to the houses we stayed in, with mosquito nets.” There were other experiences mentioned, and though not all of them mentioned spending extended periods of time outdoors camping, there were no overtly negative experiences discussed.

A final question related to specific outdoor experiences was for respondents to describe any reasons there might have been for a lack of time spent outdoors. The most common response was adverse weather conditions, either due to severe weather where it was unsafe, or just a general feeling of not wanting to be outside due to extreme heat or cold. There were a few comments of parental safety concerns, with one person stating, “there were times when my mom did not want us to explore our neighborhood alone, mainly safety concerns. It was a very diverse city. [My] parents didn’t think the neighborhood was the best so we weren’t

allowed to ride our bikes around alone.” Other less often mentioned reasons for a lack of time spent outside were illness, homework, or “if I was distracted by video games or TV.”

Most of the comments to this point were related to specific experiences outdoors during middle childhood adding depth to the statistical information obtained from the NES portion of the survey. In the following sections, specific comments from interviewees are included to provide context to the particular research hypotheses outlined in previous chapters.

Outcome Measure 1: NES and Environmental Knowledge

H₁: There is no significant correlation between an individual's NES score for outdoorsiness and a higher score of environmental knowledge. (Recall that a higher NES score reflects a higher level of outdoorsiness.)

Before the correlation analysis, it was necessary to test each variable for normality. Normality, and bivariate normality, are basic assumptions of correlation analysis. Testing each variable for normality is considered a necessary condition for bivariate normality, though it is not a sufficient condition. Upon visual analysis (Figure 4-6), it appeared that both the environmental knowledge scores and the NES scores were normally distributed. However, using the Shapiro-Wilk method of testing, the environmental knowledge scores were not normally distributed, while the NES scores were normal, using an overall $\alpha = .05$ (see Table 4-7). Using Tukey's method (hinges of 1.5) of testing for outliers, it was determined that scores below 0.5 and above 19.5 should be modified to fit within the bounds of the lower and upper quartiles, respectively (Seo, 2006). Only 4 values reflected outliers (two on each end). Recalculating normality using the modified values, the distribution again was not distributed normally (sig.

value = .000). Unfortunately, no data transformation produced a normal distribution. It can be argued, however, that due to the large sample size ($n=382$), normality was not critical. For analysis purposes, the scores for environmental knowledge were left in the original (untransformed) form.

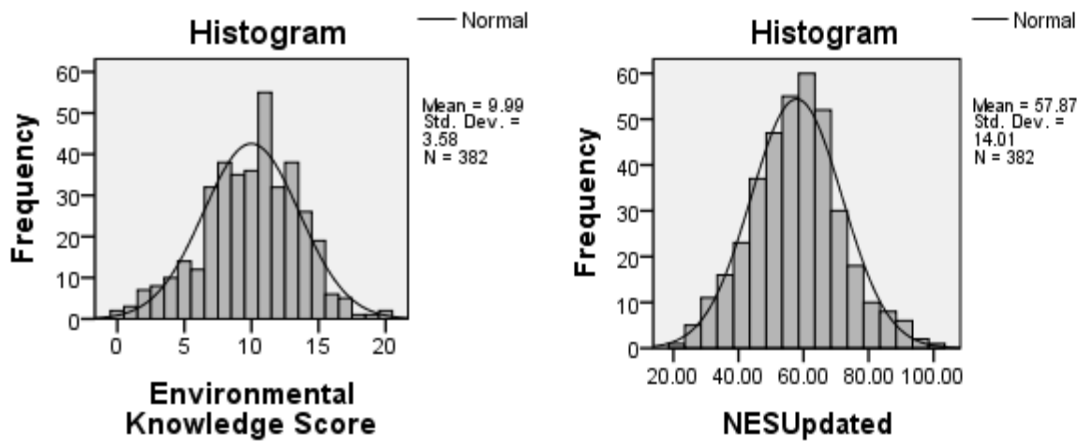


Figure 4- 6 - Histograms of environmental knowledge and NES score distributions.

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Environmental Knowledge Score	.095	382	.000	.985	382	.001
NESUpdated	.045	382	.058	.995	382	.224

a. Lilliefors Significance Correction

Table 4- 7 – Statistical tests of normality for environmental knowledge and NES scores.

Correlation was used to summarize the overall relationship between environmental knowledge scores and NES scores. Pearson's correlation (r) was used to describe the degree of linear relationship. The r -value was .112 with an associated prob-value $p = .029$, indicating a significant positive relationship of higher NES scores associated with higher environmental

knowledge scores (see Table 4-8). However, r -values <0.35 are generally considered weak and may not highlight a meaningful correlation between variables (Taylor, 1990).

Correlations		Environmental Knowledge Score	NESUpdated
Environmental Knowledge Score	Pearson Correlation	1	.112*
	Sig. (2-tailed)		.029
	N	382	382

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4- 8 – Correlation statistics between environmental knowledge scores and NES scores.

Along with the assumption of bivariate normality, it was assumed there is linearity between variables rather than curvilinearity. A third assumption taken into account is that of

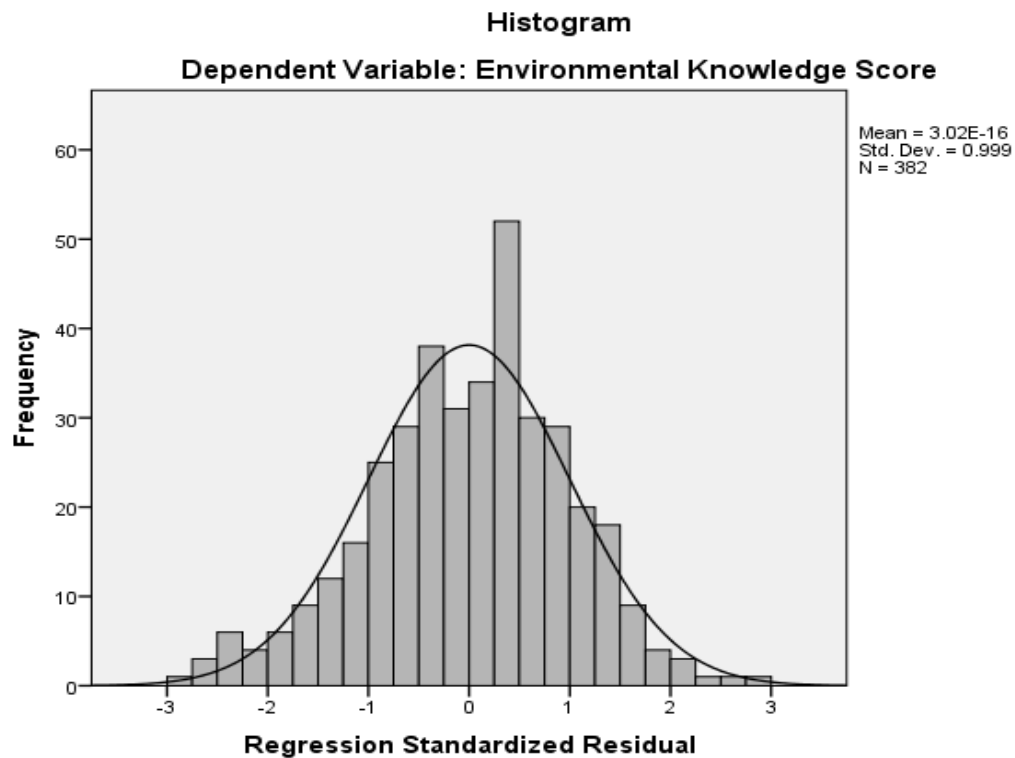


Figure 4- 9 – Figure Histogram of the residuals from the regression analysis.

homoscedasticity, or equal variances, where variances along the line of best fit remain similar moving along the line. These assumptions were both confirmed through an examination of the scatterplot of NES scores versus environmental knowledge scores.

Results from the regression analysis supported the conclusion from the correlation analysis that there is a significant linear relationship between environmental knowledge scores and NES scores, but also extremely weak. The coefficient of determination, r^2 , refers to the strength of the relationship between variables and what percentage of variation is explained. Here, $r^2 = .011$, indicating that only about 1% of the variation in environmental knowledge scores was explained by NES scores. Again, this stresses the weakness of the relationship. The final step was to test the residuals from the regression analysis for normality. As with the original environmental knowledge scores, visually the residual data appeared normal with the exception of one bar (0.25-0.50 value) (see Figure 4-9). However, the Shapiro-Wilk statistic suggested non-normality (sig. value = .025, $\alpha = .05$), likely due to the single bar extending beyond the normal curve. Again, this statistically significant result is likely due to such a large sample size.

The concern of sample size initiated further investigation into the meaning behind the statistically significant results reported. With regard to hypothesis testing and Type I and Type II errors, it is widely understood that the probability of these errors goes down as the sample size goes up, increasing the likelihood of a statistically significant result even if a meaningful one does not exist (Cohen, 1992). For this reason, effect size was calculated to help better understand the relationships found through correlation and regression analyses. Effect size is used to determine more precisely how large an effect observed in the data really is. In the case

of a correlation analysis, the effect size and r are the same. The effect size of the NES, environmental knowledge correlation was $r = .112$, which is considered a small effect (Cohen, 1992).

In order to examine the relationship of NES score and environmental knowledge a little more closely, interviewees were asked how they thought outdoor play as a child might have affected their knowledge of the environment. Generally speaking, it seemed difficult for interviewees to make a conscious connection between being outside and learning about the environment. One person summed it up like this, “I don’t know how to answer that. Well, if you’re asking what poison ivy was, no. I guess my experience was limited in learning because I didn’t have problems. You know what I mean? Does that make sense? ‘Cause I think if I was allergic to poison ivy, I would know what poison ivy looked like. If I was allergic to bee stings, I would pay attention to that.”

To gain more clarification, the question was rephrased asking if one caused the other: did being outside cause learning about the environment, or did learning about the environment cause them to spend more time outdoors? Interestingly, most of the comments suggested that being outside led to more learning, with comments such as “the more time I spent outside, the more I learned.” And “the only way you know how to deal with certain animals is if you are around them. Like snakes. I never sat down and was taught this snake is poisonous so don’t touch it.” Additional comments related to environmental knowledge acquisition is discussed in more detail with regard to outcome measures 4 and 5.

Outcome Measure 2: Gender, NES, and Environmental Knowledge

H₂: There is no significant difference in mean NES scores between males and females.

Consistent with the data analysis methodology, independent samples *t*-tests were conducted on the NES and environmental knowledge scores to examine differences in mean scores between males and females. As with the previous correlation and regression analyses, $\alpha = .05$. For NES scores, males and females scored an average 58.6 ($SD = 14.3$) and 57.6 ($SD = 13.9$), respectively. No significant differences were found between mean NES scores of males and females; $t(381) = .57, p = .57$. We thus failed to reject the null hypothesis of no difference in NES scores between males and females in level of outdoorsiness. As with the previous correlation analysis, due to the rather large sample size, the effect size was calculated to better understand the difference in means between the two groups. Effect size (Cohen's *d*) was found to be $d = 0.06$. This value means that the two groups, males and females, do not differ by more than .06 standard deviations, a value considered small (Cohen, 1992). In essence, there is no difference in mean NES scores between males and females.

Though not explicitly stated as a research hypothesis, a difference of means was also conducted between males and females on environmental knowledge scores. With the determination of a weak linear relationship between NES and environmental knowledge, it was expected that since there was no difference in means between males and females on NES scores, there would also be no significant difference in environmental knowledge scores. As with the findings of male and female NES scores, males also scored slightly higher than females on environmental knowledge, 10.4 versus 9.76, respectively. However, this was also found to be a non-significant difference $t(381) = 1.56, p = .12$, with males only scoring an average of .64

points higher than females. There was a small effect size for environmental knowledge scores of the two groups, $d = .18$. Table 4-10 summarizes these results.

As just described, there was no significant difference of mean NES scores between males and females. Additionally, comments and descriptions of outdoor experiences from the interviewees supported little to no difference in such experiences between males and females. It was clear that particular experiences were much more focused on individual occurrences rather than any difference in gender.

Scale	Male (n=108)	Female (n=274)	<i>t</i>	<i>Sig. value (p)</i>	<i>d</i>
NES	57.5 (14.7)	56.7 (14.3)	.570	.57	.06
Environmental Knowledge	10.4 (3.41)	9.76 (3.63)	1.56	.12	.18

Number in parenthesis are standard deviations. *Sig. value = $\alpha < .05$.

Table 4- 10 – Mean scores of environmental knowledge and NES by gender.

Outcome Measure 3: Setting, NES, and Environmental Knowledge

H₃: There is no significant difference of mean NES scores between individuals raised in various settings (urban, suburban, rural, and farm).

An ANOVA was used to compare the means between different environments where respondents spent a majority of time during their middle childhood (urban, suburban, rural, or farm). Descriptive statistics of each of the environments and NES and environmental knowledge scores are displayed in Table 4-11. For NES score, the test of homogeneity of variances ($p = .533$) explained there was no significant difference in variances between groups. With a $p = .530$, it was determined that there was no significant difference in NES scores across the various environments. Thus, it was not necessary to check the multiple comparisons output from SPSS. Although those respondents from Rural and Farm environments scored higher on the NES than

those from Urban or Suburban environments, the null hypothesis failed to be rejected that no significant difference existed between groups.

Environment	NES		Environmental Knowledge	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Urban (n=63)	71.9	15.8	8.79	3.91
Suburban (n=245)	73.8	15.3	10.0	3.46
Rural (n=66)	76.0	16.5	10.71	3.58
Farm (n=8)	73.6	15.6	9.75	2.38

Table 4- 11 – Mean scores of environmental knowledge and NES by environmental setting.

Though no statistically significant results were found between groups based on environmental setting and NES scores, some interviewee comments suggested that some differences in outdoor experiences did exist. Of the fifteen interviewees, one moved around quite a few times living in a mix of rural and suburban environments, one grew up on a farm, one grew up in a rural town, three were raised in a primarily urban setting, and the remaining nine grew up in the suburbs.

There were three instances where the ‘full-time’ home environmental setting (the period of time during the school year) was substantially different from the summer environment. As previously mentioned, one person spent middle childhood in three very different environments due to the family being relocated. Another person spent the school year in an urban environment, only to spend three months of summer vacation on a farm in Montana. A third person lived in suburban Arkansas during the academic year and would then travel to the lakes on Minnesota to spend summers in the woods and on the water. This presented an interesting discussion of how people define their ‘home environment’ as well as a

larger question of how to accurately account for singular home experiences during middle childhood. Clearly, this created a dilemma when looking at how an individual relates to a given environment. This topic is addressed in greater detail in the discussion chapter.

As with the gender analysis, a separate ANOVA analysis was conducted to see if there was a significant difference between groups based on environmental setting and environmental knowledge. Based on previous cited research, the null hypothesis was that no significant difference would exist. The test of homogeneity of variances ($p = .283$) increased the confidence that the assumption of equal variances for the ANOVA analysis was met. With a $p = .020$, it was determined that there was a significant difference in environmental knowledge scores among groups. Only a single p -value from the multiple comparison tests was found significant, between Urban and Rural groups ($p = .012$). Approaching significance was the difference between Urban and Suburban ($p = .065$). Respondents from Urban environments scored on average, 1.92 points lower than those from Rural environments. The effect size ($d = .51$) suggested this was a medium effect, where the means between the two groups differed by half a standard deviation (Cohen, 1992). Although the sample sizes among groups did vary by quite a wide margin, this assumption was relaxed due to homogeneity of variances (Keppel, 1991). For a more complete investigation of the difference of means, a multiple analysis of variance (MANOVA) was run with NES and environmental scores as the dependent variables, and home setting as the independent, categorical variable. The Wilks' Lambda statistic from multivariate tests produced a value $p = .56$, indicating that neither environmental knowledge nor NES scores were dependent on home setting. The univariate ANOVAs resulting from the MANOVA yielded p -values of .012 and .530 for environmental knowledge and NES scores,

respectively. These were the same results as the two separate ANOVAs performed for NES scores and environmental knowledge scores separately.

Outcome Measure 4: Education, NES, and Environmental Knowledge

H₄: There is no significant difference of mean environmental knowledge scores between individuals taking more science courses and fewer science courses during formal education (high school and university).

Formal education with a specified curriculum is a common method by which to transfer information from ‘experts’ to students. As part of the survey, participants were asked to identify the number of science courses they had taken throughout their formal schooling from elementary to the university level. For purposes of analysis, only high school and university courses were used in the analysis due to the lack of course choice during formal schooling at the elementary and middle school level. The selection options for high school science courses were zero, one to three, or four or more. Only two participants indicated they had taken zero science courses while in high school. Four participants replied with Don’t Recall. Due to the small sample size in the Don’t Recall and Zero groups, only samples from the one to three and four or more science courses were used in analysis. The mean environmental knowledge and NES scores can be seen in Table 4-12. There was a statistically significant difference between the groups of one to three classes versus four or more classes as determined by an independent samples t-test; $t(374) = -3.80, p = .000$. Individuals reporting taking one to three classes score an average 9.27 ($SD = 3.30$) on the environmental knowledge survey while those taking four or more classes had an average score of 10.64 ($SD = 3.61$). The null hypothesis was

therefore rejected, concluding there was a statistically significant difference in the mean environmental knowledge score between individuals taking one to three science classes in high school and those taking four or more. This was further supported by a nearly medium effect size, $d = .40$.

Number of science specific courses in high school	N	Environmental Knowledge Score (<i>Mean</i>)	NES Score (<i>Mean</i>)
One to Three	166	9.27	70.99
Four or more	210	10.64	76.03

Table 4- 12 – Mean scores of environmental knowledge and NES based on number of science specific high school courses.

It was also concluded that there was a statistically significant difference in mean NES scores between groups one to three and four or more science classes as calculated using an independent samples t -test $t(374) = -3.17, p = .002$. Mean NES scores for individuals taking one to three science classes and four or more were 71.0 ($SD = 15.1$) and 76.0 ($SD = 15.5$), respectively. These results yielded a small to medium effect size, $d = .33$.

At the university level, selection options were zero, one, two to five, and six to ten, specific science courses. There was a statistically significant difference between groups as determined by one-way ANOVA ($F(4,377) = 5.18, p = .000$). A Tukey post-hoc test revealed that environmental knowledge scores were significantly higher for participants who had taken two to five university science courses (10.54 ± 3.4) compared to participants who had taken a single science courses ($9.50 \pm 3.6, p = .043$). There were no statistically significant differences between zero and a single course ($p = 1.000$), between zero and two to five courses ($p = .891$), or between zero and six to ten courses ($p = .902$). Additionally, there were no significant differences between a single course and six to ten courses ($p = .650$), or two to five courses and

six to ten ($p = .999$). As with mean scores from the number of high school science courses taken, a lack of significance of mean environmental knowledge scores and the number of university courses is likely due to the small number of students identifying with zero and the six to ten courses taken (see Table 4-13). An effect size of $d = .05$ supported the lack of difference between groups. An ANOVA was also run with NES scores and university sciences courses. The only significant difference existed between participants who took two to five and six to ten courses ($p = .031$). This level of significance was taken with some skepticism due to the low number of samples ($n=16$) at the six to ten course option.

Number of science specific courses at the university	N	Environmental Knowledge Score (<i>Mean</i>)	NES Score (<i>Mean</i>)
Zero	10	9.50	56.65
One	174	9.50	57.00
Two to Five	179	10.54	58.37
Six to Ten	16	10.75	67.25

Table 4- 13 – Mean scores of environmental knowledge and NES based on number of university science courses.

As a means of further exploring the possible differences between groups, independent samples t -tests were calculated. This included tests for the groups of individuals taking one science course and two to five courses on NES and environmental knowledge scores. A significant difference in mean environmental knowledge scores was computed; $t(351) = -2.82$, $p = .005$. The effect size was considered small to medium, $d = .30$. There was no significant difference in mean NES scores between the groups.

In addition to exploring a difference of means, a correlation analysis was performed to determine if any relationship existed with formal education and environmental knowledge scores. An additional variable was calculated to determine total science education. Total science education values used only high school and university science courses. Point values were assigned based on the number of courses taken at each level (*e.g.* for high school: Zero =

2, One to Three = 3, and Four or more = 4; for university: Zero = 2, One = 3, Two to Five = 4, Six to Ten = 5, and Ten or more = 6).

Positive correlations were found in all instances, and all were statistically significant. Correlations of environmental knowledge with high school science, university science, and total science education were: $r = .215, p = .000$; $r = .189, p = .000$; and $r = .237, p = .000$, respectively. The results led to a rejection of the null hypothesis (H_4). This did represent a significant positive relationship; however, this was a relatively weak positive correlation as previously described and outlined by Taylor (1990). The association of correlation values to effect size supported a small relationship between formal education and environmental knowledge scores. The coefficient of determination, r^2 , was calculated at $r^2 = .056$, indicating only 6% of variation in environmental knowledge scores was explained by secondary science education. This relationship is stronger than that for NES scores and would suggest that total science education provides a somewhat better explanation of environmental knowledge than outdoorsiness.

As previously discussed, several interviewees commented on their views of learning about the environment through outdoor play or through formal education. While no one suggested that they didn't learn anything from their formal science classes, none of the interviewees specifically mentioned their formal education as the primary means of acquiring knowledge about their environment. One interviewee commented, "if you're never out there, you don't know what you're, you know, you have no experiences to base it off of." Probing a bit further, it was suggested to the interviewee, "but you could sit through a lecture." The interviewee replied, "yeah, but you have to experience it first-hand. And you sit through a lecture you only get a snap shot, the one the person is giving you. You still have to funnel it

through your own experience.” Another comment supported this idea, that “knowing more made me more curious which led me to the outside.” Though this was not a research study aimed at determining the cause and effect relationship of learning environmental knowledge and outdoor experiences, the rephrased question seemed to garner more thoughtful and reflective responses related to those experiences.

Outcome Measure 5: Free-choice Learning, NES, and Environmental Knowledge

H₅: There is no significant correlation between an individual’s environmental knowledge score and their free-choice learning experiences (a subset of NES score).

Free-choice learning, also sometimes referred to as non-formal learning, is those experiences where the participant engages in activities or learning without a specific curriculum (e.g. visits to science centers, national parks, and local botanical gardens and arboretums) (Falk, Storksdieck, & Dierking, 2007). As with formal education, the variable of free-choice learning was calculated by combining point values from each of three specific questions on the NES scale related to outdoor free-choice learning experiences (see Table 4-14).

Free-choice Learning Items
My family took trips to the zoo or botanical gardens.
I participated in multi-day trips to natural areas.
I took camping trips with my family or friends.

Table 4- 14 – Three free-choice learning items included in the NES.

A correlation analysis was performed to determine the possible relationship with environmental knowledge scores and free-choice learning experiences. As part of this analysis, correlation was also calculated with NES score and free-choice learning. Since the variable of free-choice learning was included as a portion of the NES, a positive correlation between the two was expected. A significant positive correlation was found between NES score and free-

choice learning ($r = .630, p = .000$). This represented a moderate to strong positive correlation (Taylor, 1990). However, with regard to a relationship between environmental knowledge and free-choice learning, there was almost no relationship ($r = .006, p = .905$). Therefore the null hypothesis failed to be rejected.

Predictors of Environmental Knowledge

A multiple regression was performed to determine the most likely predictor of environmental knowledge scores based on various modes of knowledge acquisition: outdoorsiness as measured by the NES, total education as determined by the number of science courses taken in high school and at the university, and free-choice learning experiences. In order to determine which variables were to remain in the multiple regression equation, entry and removal values in SPSS were set at .05 and .10, respectively. Using the stepwise calculation method, Model 1 showed an adjusted r^2 value of .054, indicating that nearly 6% of environmental knowledge scores were explained by a person's total education (science). The two remaining variables had p -values larger than .05 and were therefore not entered into the equation (NES $p = .177$, Free-choice learning $p = .633$).

Two key assumptions were considered in the multiple regression analysis, a linear relationship and homoscedasticity, or equal variances. From looking at the scatterplots of variables included in the regression analysis (see Figure 4-15), there was little concern over non-linear relationships. There was some concern with the assumption of homoscedasticity; however, due to the normality of the individual variables, data transformations such as natural log and square root did not yield any more promising results. Cook's distance was calculated to

look at the effects of each observation on the regression equation and to determine if there were any cases distorting the solution from the multiple regression. There is no significance test for Cook's distance. However, distance values greater than 1 are considered large (Cook & Weisberg, 1982) and may be discarded. For this data set, the range of distances was .000 to .112. Finally, residuals from the regression analysis were tested for normality. As with the residuals of NES scores, visually, the data appeared normal. However, the histogram of residual values displayed some peaks above the normal curve (see Figure 4-16). The Shapiro-Wilk statistic ($p = .007$, $\alpha = .05$) would support this conclusion, again, likely due to such a large sample size.

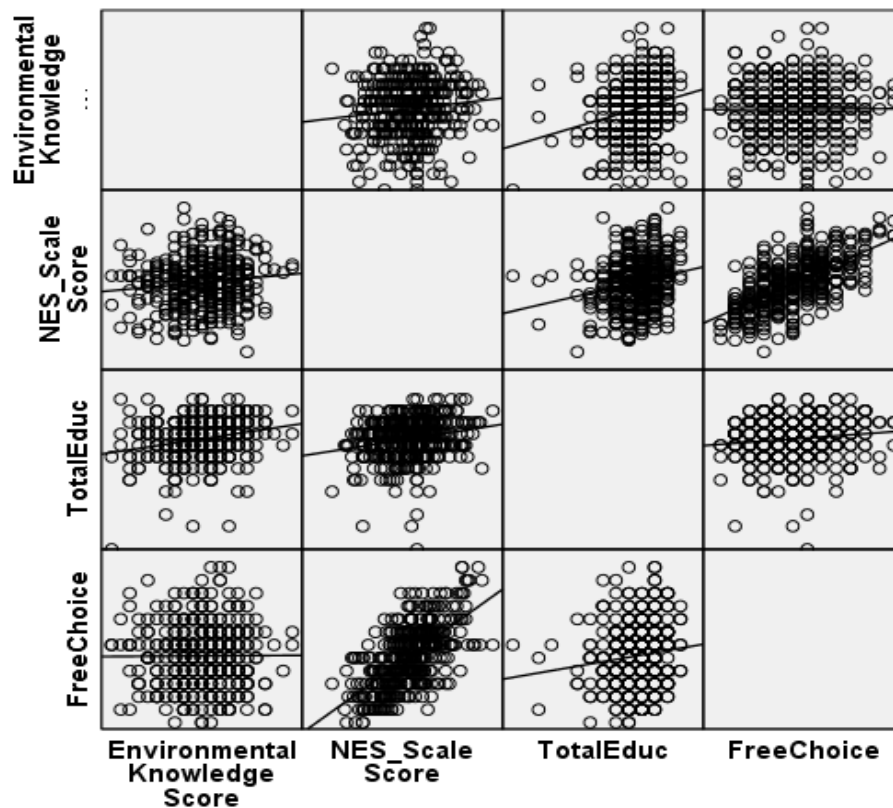


Figure 4- 15 – Scatterplots of variables included in linear regression analysis.

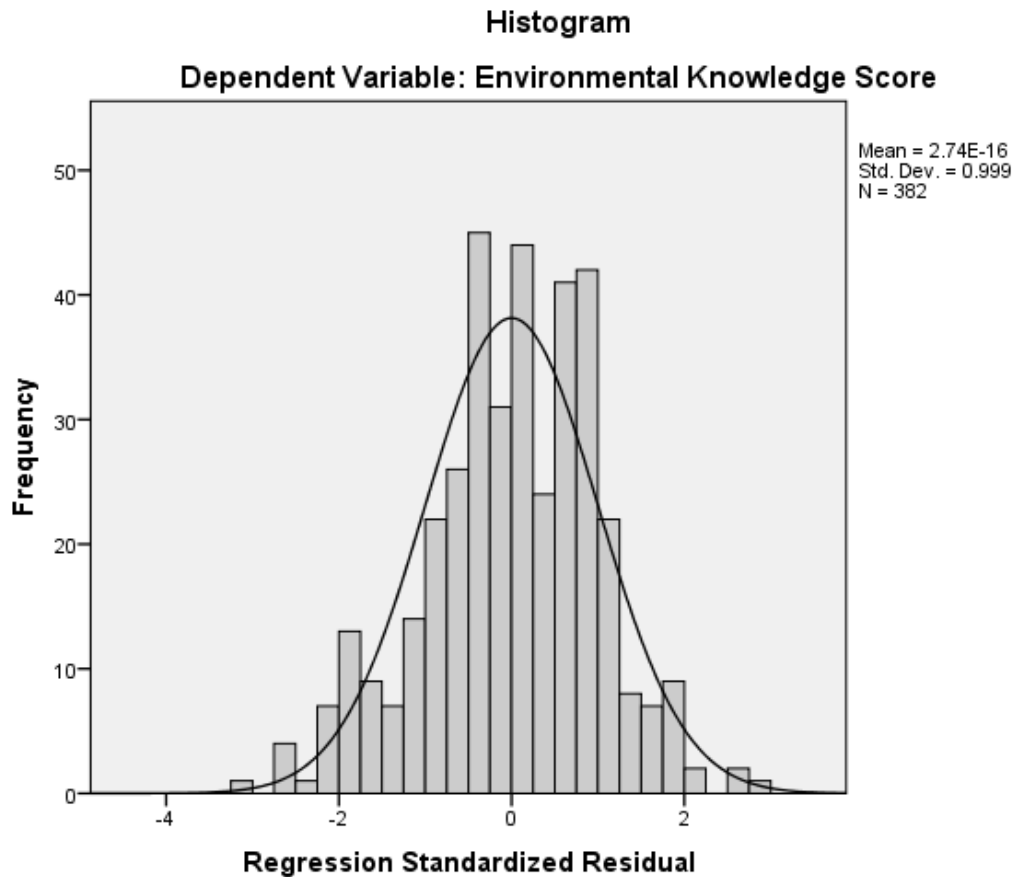


Figure 4- 16 – Histogram of residual values from linear regression.

The concept of free-choice learning was one of those interesting ideas that were seemingly unfamiliar to the interviewee group. Thus, the questions were framed around specific types of free-choice learning activities one might participate in, specifically family vacations or multi-day trips to natural areas. Several remarks in regard to participation in multi-day trips and the relationship to natural experiences scale items were included in the section Outcome Measure 1. However, in a slightly different context, a couple of interviewees did mention their involvement in leadership type training workshops conducted over multiple days and primarily in natural settings. One such camp was near a 4H site just outside of Junction City, KS where it was noted “it was a nice time out there because you get to see the stars and

everything.” Of a different camp, another interviewee mentioned participating in high ropes training and basic survival [team building] skills.

The subject of family vacations was certainly an interesting one, and as could be expected, ran the gamut of never going on vacations due to financial constraints to traveling every year to see Mickey Mouse. The actual interview questions were phrased as “describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, hunting/fishing, climbing, etc.)?” In response to the issue of financial limitations, one person remarked, “there were not a lot of vacations so that’s why I like to spend a bunch of my time outside. Being outside is like my vacation, that’s how I like to kind of, have a place to be free in a sense, do what I want.” For similar reasons, other vacations were planned around big family events as one person commented, “our vacations were not vacations per se. My cousin got married in North Carolina, so we’d go to North Carolina for the wedding, then we’d go to the beach. It was always like we have to be there anyways, so let’s do a vacation afterward.”

Some families traveled a couple of times a year; as one person noted, “my family would go on one or two family vacations a year (excluding road trips to visit family during the holidays). We traveled to a variety of places (beaches, amusement parks, skiing, cruises, Yellowstone, etc.), but none of our vacations were really planned with nature in mind.” Another individual traveled every summer with their family, often going to “the beach or visited our lake house in Minnesota. Our vacations were more planned around being outdoors.” The trips weren’t always fancy, and sometimes it was more a matter with whom, than to where. One person said, “Our big summer trips every year were camping with a group of ten families that

had kids, from year to year. We went to the same place. We boated and camped, and campfires and stuff.” Still others traveled less often and so had distinct memories of a particular trip, “sleeping in the grass, in the middle of the Sheraton parking lot (on a trip to Washington D.C. He’s [dad] cheap.” One individual commented, “We didn’t take actual vacations. If we traveled, it was to visit family where my dad would build stuff for my relatives. An aunt lived in Atlanta so in 1996 we went to the Olympics.” Many other of the interviewees offered incredible stories of multi-day to multi-week trips during their childhood, from the big cities of the United States to the desert and mountains of the west. Unfortunately it was not possible to include all accounts of individual experiences in this study.

Summary

Reliability analyses were performed before addressing the five research hypotheses tested in this study: environmental knowledge ($\alpha = .70$), NES ($\alpha = .92$), and environmental knowledge and NES combined ($\alpha = .88$). The first statistical analysis revealed a significant positive relationship between outdoorsiness and environmental knowledge. However, the resulting correlation was very weak. With regard to gender, it was found that males scored higher than females on both the NES and environmental knowledge, though the results were not significant. The environment where a child was raised was of interest due to research suggesting children during middle childhood are now spending less time outdoors. The question was whether or not environment or access to wild spaces may be a factor. Participants from urban and suburban environments did have lower scores on the NES than those from rural or farm environments, though not significantly lower. For environmental knowledge scores, there

was a significant difference in mean scores between participants from urban environments and those from rural environments, with those from urban environments scoring lower. See Table 4-17 for a summary of the key findings.

Outcome Measure	Key Findings
<i>H₁: There is no significant correlation between an individual's NES score for outdoorsiness and a higher score of environmental knowledge.</i>	There was a significant positive relationship between outdoorsiness and environmental knowledge.
<i>H₂: There is no significant difference in mean NES scores between males and females.</i>	There was no difference between males and females on NES or environmental knowledge.
<i>H₃: There is no significant difference of mean NES scores among individuals raised in various settings (urban, suburban, rural, and farm).</i>	There was no significant difference NES scores based on participants home environments. Participants from urban environments scored significantly lower on environmental knowledge than those from rural environments.
<i>H₄: There is no significant difference in mean environmental knowledge scores between individuals taking more science courses and fewer science courses during formal education (high school and university).</i>	Participants taking four or more science specific courses in high school scored significantly higher than those who took fewer than four classes. Participants taking two to five science courses at the university level scored significantly higher than those who had fewer courses.
<i>H₅: There is no significant correlation between an individual's environmental knowledge score and their free-choice learning experiences (a subset of NES score).</i>	There was a significantly positive correlation with free-choice learning and NES scores. There was no significant relationship with environmental knowledge scores and free-choice learning.

Table 4-17 – Summary of key findings.

Another area of interest for the study was the impact of formal, science-specific education on NES and environmental knowledge scores. Only high school and university science courses were considered for analysis due to the lack of student choice at the elementary and middle school level. Students with more science from both high school and university levels yielded higher environmental knowledge scores. Participants who had taken four or more science specific courses in high school scored significantly higher than those who took fewer than four classes. At the university level, those participants who had taken two to five science specific courses scored significantly higher than those who had fewer courses. Separate ANOVA tests were run to determine if any differences existed between NES and science-specific

courses in high school and at the university. One pair of significant differences between groups was found to exist at each education level.

Free-choice learning, or those experiences not tied directly to a formal curriculum were found to have a significantly positive correlation to NES scores. However, free-choice learning was found to have almost no relationship with environmental knowledge scores. Lastly, a multiple regression analysis containing free-choice learning, NES scores, and total formal education was calculated. Total formal [science] education was found to be the most likely predictor of environmental knowledge scores.

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Chapter Five

Summary, Discussion, and Conclusions

“I sincerely believe that for the child, and for the parent seeking to guide him, it is not half so important to know as to feel when introducing a young child to the natural world. If facts are the seeds that later produce knowledge and wisdom, then the emotions and the impressions of the senses are the fertile soil in which the seeds must grow. The years of early childhood are the time to prepare the soil.” – Rachel Carson, A Sense of Wonder

This chapter discusses the implications of findings regarding environmental knowledge and the natural experience scale (NES), and various relationships of each with gender, home environmental setting, and formal education. The chapter also includes discussions of study limitations and directions for future research. There were three distinct purposes of this study. The first was to develop a reliable construct to measure a person’s level of outdoorsiness (natural experience scale, NES). The second was to examine the relationship between outdoorsiness and environmental knowledge. Additionally, there was an investigation of whether gender or environmental setting during middle childhood had an impact on the level of either outdoorsiness or environmental knowledge. The final purpose was to determine what other factors may be associated with environmental knowledge: formal [science] education and free-choice learning. As described in the methodology chapter, a focus group of five subject matter experts was consulted to discuss the results of this study and offer insights to the validity and reliability of the study. Their comments are included throughout the discussion.

Survey Measurement and Discussion

The survey was designed to collect information about a person’s outdoor experiences during middle childhood (age 6-11) along with current environmental knowledge (as an adult).

Demographic information, formal [science] education, and experiences in free-choice (informal) learning were also collected. All statistical tests were run using SPSS 20.0. This section discusses the measurement of the two survey constructs, NES and environmental knowledge, as well as implications for the results of values obtained from each measure.

Natural Experience Scale (NES)

Previous research has concluded that outdoor experiences increase creativity, cognitive functioning, and environmental knowledge specifically (Andrejewski, 2011; Atchley *et al.*, 2012; Kellert, 2002). In addition, various methods for measuring an individual's outdoor experiences have been developed. (Kellert & Derr, 1998; Mayer & Frantz, 2004; Nisbet *et al.*, 2009). In this study, a new scale, the natural experiences scale (NES), was developed to include the most direct statements related to authentic, hands-on experiences in nature (*i.e.* outdoorsiness), rather than just a feeling of connectedness to nature. The intent was to create a diverse set of statements for individuals to identify with in terms of variety of activities and frequency of engagement. A number of the statements were also developed from conclusions drawn by Gardner (1999) in his discussion of multiple intelligences, specifically the naturalist intelligence.

The modified NES used for statistical tests throughout the study contained 22 items ($\alpha = 0.92$). Out of a possible 110 points, the minimum score for all participants was 22, the maximum 104, and the mean 57. A very broad interpretation of this measure is that respondents from this sample spent less than 50% of the time outdoors during middle childhood. A more detailed explanation of this measure is somewhat more complicated on the basis of determining cause and effect. Previous research (Clements, 2004; Rideout *et al.*, 2010;

Strasburger *et al.*, 2010) concluded children are spending less time outdoors and more time inside 'being entertained' by more access to media. In fact, during the interview portion of this study, when asked what factors might have contributed to reduced time spent outdoors, one individual commented, "The only restrictions I had would be weather or if I was distracted by video games or TV."

Rideout *et al.* (2010) indicated children (age 8-18) today are spending nearly 7 hours a day using entertainment media. How many of these are hours during the summer when children are out of school? How many hours a day are children sleeping or engaged in other activities? These are just a few of the questions that make interpretation of this type of data difficult. Also, consider the nature of the NES items asking respondents to identify their frequency of engagement in a given activity during middle childhood using a Likert scale. In the context of time, what does a response of 'Almost Always' mean with regard to time spent observing the night sky? There are only so many hours in a day and individuals are often engaged in a variety of activities throughout the course of an entire day.

Another factor to keep in mind is the multi-year time gap between participation in an activity and response. It is well known that the more time that has elapsed between actual engagement in activity and the response to questions about that activity increases reporting inaccuracies (Fowler, 1995). One way to help minimize this effect was to be more specific with the reference to middle childhood, selecting a specific age range (6-11) (Fowler, 1995). Though this was found to be a reliable scale statistically, it did not apply to how well an individual remembered something. One way reporting accuracies might be increased in future studies would be to ask individuals closer in age to the target age range of middle childhood.

This would help to decrease reporting inaccuracies that grow as one becomes more distant from the event being measured. Additionally, to verify the previously referenced literature citing decreased exposure to the outdoors among the current generation of young people, this scale could be given to individuals from different age groups. From this, ANOVA tests could be run to determine if there are any differences between generations of individuals and the amount of time they spent outdoors during their childhood. The focus of future applications would still center on engaging in authentic exploration and interaction with the outdoors rather than on affective attributes as with previous studies (Andrejewski, 2011; Mayer & Frantz, 2004; Nisbet *et al.*, 2009). From an extensive literature search, this appears to be one of the first attempts to collect and quantify an individual's active engagement in nature.

An area of concern addressed by the focus group was the selection of the age range of 6-11, middle childhood, when "our society technically considers one a child until age 18." The focus on middle childhood was outlined in the 'significance of study' section of Chapter 1, indicating that this is generally considered a critical time in the development of an individual's problem-solving, creativity, and emotional and intellectual connections in a broader context of the environment. The concern dealt with the complex issue of an individual being able to consciously separate a set of experiences within a specific time frame (age 6-11). While maintaining the research interest of middle childhood, a minor change or clarification of time frame, possibly the reference to a particular grade in school, might have helped to increase the reporting accuracy among individuals.

Environmental Knowledge

Consistent with previous research (Arcury, 1990; Maloney *et al.*, 1975; Robelia & Murphy, 2012), it was found that individuals seem to lack basic understanding of their environment. However, it has also been noted that environmental knowledge is difficult to measure (Maloney & Ward, 1973; Robelia & Murphy, 2012). As described in the Methods chapter, this is why the environmental knowledge questions were adapted from previously published studies, so as not to create an entirely new set of environmental knowledge questions. The environmental knowledge scale consisted of twenty multiple-choice items ($\alpha = 0.70$). Out of a possible 20 points, the mean score was 10, though the most common score was 11. Based on the traditional grading scale (A, B, C, D, F), only 15% of respondents scored a C or better (70%, or 14 out of 20). Participants were given the answer option of 'Don't Know.' This consideration was addressed previously and confirmed as an acceptable option through discussion with the focus group. One member of the group commented that they had used the answer option of 'Don't Know' in previous research with test subjects because "I didn't want them to guess and just happen to select the correct answer. There was a way to select "I don't know" and it didn't skew the data. It was just another category and went into the bulk of wrong answers."

Briefly outlined in the Results chapter, the environmental knowledge assessment was subdivided into six topic categories: animals, energy, general, pollution, recycling/waste, and water. The percentage scores used in the following section are used for comparison purposes only. The category with the lowest score was pollution (34%). This is somewhat surprising in a broader context, given the frequency with which stories about [air] pollution appear in

mainstream media. However, of the three questions in this category, only one was related to air pollution, while the other two were about water and soil pollution. The question about soil pollution scored the lowest on the entire test (16%). This is of particular concern with regard to the food web and the bioaccumulative nature of a number of particularly harmful chemicals commonly found in pesticides and herbicides (Hao *et al.*, 2005). Related to this was the relatively low score (28%) on identification of the major sources of water pollution as surface runoff from yards, city streets, paved lots, and farm fields. These are areas where a majority of individuals are active on any given day. In general, those items asking questions about specific chemicals involved in a particular process tended to have lower scores. This result is not overly surprising. It would seem unlikely that an individual participating in any given outdoor activity, take fishing for example, would know (or learn) that mercury is a common poison found in fish, simply from participating in the activity itself.

Another area of concern was the category of recycling and waste, with an average score for the three questions of 37%. Despite increasing state and local level regulations on mandatory recycling and waste reduction programs (Mooney, 2014; Viscusi *et al.*, 2011), a majority of the respondents in this study had little knowledge of the topic. This seems to be in contrast to findings from previous studies about knowledge of waste disposal and recycling (Robelia & Murphy, 2012). However, as one person commented during the interview process, “I think it’s a matter of awareness. I didn’t learn about recycling until I moved away from home. We lived on a farm. We burned our trash. They still do. I try to recycle when I go home but that’s only once every three to four months and I just can’t fit everything.”

Another area of contrast to previous studies is that of energy or energy production. The three items making up the energy category in this study yielded an average score of 68%. Other studies have cited lower scores (28% to 60%) on similar questions (Robelia & Murphy, 2012). The remaining categories (animals, water, and general environmental knowledge) presented mixed results, in line with previous research (Robelia & Murphy, 2012). The differences in scores between previous studies and the current research underscore the previously noted difficulty of measuring environmental knowledge. This is despite the attempt to compose an assessment with similar items to those used in previous studies.

As referenced in the review of literature, the primary goal of environmental education is to increase environmental knowledge. One of the ways organizations, schools, and parents are attempting to do this is to get children outside (Louv, 2008). One focus of this movement is to not only increase the appreciation of the natural world, but also to better understand connections and the interrelatedness of humans to their environment (Louv, 2011). One interviewee actually captured this idea of connectedness stating that being outdoors “definitely made me aware of all that goes on within outdoor environments. It’s important to preserve them and coexist with the organisms that rely on these spaces.”

A majority of the questions in this study asked respondents about familiarity with very specific content related to environmental knowledge (*e.g.* the most common pollutants of water). Though consistency with previous studies was maintained as previously discussed, future research of this type may wish to focus on the more interconnected nature of environmental knowledge such as predator/prey relationships. Responses to these types of questions are also more likely to change with varying degrees of outdoor experiences and

through authentic engagement with nature (Gardner, 1999). Examples for topics that might be posed for future research could include identification of various phases within the hydrologic cycle, or necessary factors for healthy plant (garden) development.

Previously described in Chapter 3 (Research Methods), the initial pilot study was conducted using environmental knowledge questions written at the 8th grade level. These were adopted from the National Assessment for Education Progress (NAEP). The questions used as part of the final survey came from three sources (Leeming *et al.*, 1995; Maloney & Ward, 1973; NEETF, 2002). However, it was not clear to what grade level these questions were written. It was merely stated that they were written to address general environmental knowledge. The complexity level of the questions was a concern mentioned by the focus group as one participant stated, “My grandfather was the most outdoorsy person I know, but he couldn’t answer a [8th grade] question. He knew a lot about stuff, but he might not know the right words or vernacular.”

Members of the focus group also inquired about the degree to which the knowledge questions address possible misconceptions, adding, “You know that’s one of the issues with all of science.” In the review of literature, one of the goals of the national environmental assessments conducted by the National Environmental Education Training Foundation (NEETF) was to identify common misconceptions surrounding environmental issues. The design of those surveys included the correct answer, two distractors, and a myth answer (misconception) (Robelia & Murphy, 2012). Those assessments then looked at the number of people answering correctly compared to those that selected the myth response. Each year questions were added or changed to reflect topics recently covered in the media (NEETF, 2005). From the beginning,

this study aimed to find a consistent and accurate measure of environmental knowledge. The concept of addressing misconceptions was considered. However, misconceptions specifically were not addressed in this study due to the evolving nature of the questions as described by NEETF (2005), in addition to the need to be more consistent in the assessment of environmental knowledge in general as described in detail in previous chapters.

As with the NES, after an exhaustive literature search, this appears to be one of the first attempts to determine how or where an individual's environmental knowledge may come from. Previous studies have used similar environmental knowledge assessments to make connections to individuals' attitudes or concern for the environment based on this knowledge (Leeming *et al.*, 1995; Swanwick, 2009; Walker & McNeal, 2013).

Research Questions and Discussion

Previous research in the area of environmental knowledge has been interested in its relationships with environmental attitudes and behaviors, also sometimes referred to as the knowledge, attitude, and behavior model (KAB) (Bamberg & Möser, 2007; Kollmuss & Agyeman, 2002; Robelia & Murphy, 2012). However, outside of assessing the effectiveness of a given environmental program such as the Outdoor School or field camps, little research exists on non-formal methods for acquiring environmental knowledge (Andrejewski, 2011; Ballantyne & Packer, 2002; Storksdieck, 2006). The NES developed to determine if any such relationship with non-formal experiences in nature might play a role in obtaining environmental knowledge.

NES and Environmental Knowledge

The original null hypothesis was that there was no significant correlation between an individual's level of outdoorsiness during middle childhood and their environmental knowledge

as an adult. The results of the correlation analysis rejected this hypothesis, concluding that there is a significant positive relationship between an individual's outdoorsiness and their level of environmental knowledge. Though statistically significant, this was determined to be a weak positive relationship, with the correlation calculation yielding an r -value of .112. Concern over such a large sample size resulted in the calculation of effect size for correlation. In such an analysis, the effect size and correlation values are the same. The resulting correlation and effect size between NES and environmental knowledge was found to be small ($r = .112$) (Cohen, 1992). Such a small value adds clarification to the relationship between NES values and environmental knowledge scores. As such, there appears to be very little connection between the two variables as measured by the instruments used in this study.

As described in some detail previously, one reason for a lack of relationship may lie in the type of questions asked as part of the environmental knowledge portion of the survey. These questions were adopted or adapted from prior research in order to maintain consistency between those previous studies. However, the purpose of those studies was not to determine the nature of environmental knowledge acquisition. Rather they were aimed at making connections between general environmental knowledge and an individual's attitudes or behaviors toward the environment. The low correlation of this particular analysis did not mean that learning was not taking place while children are playing outside. Quite the opposite is likely true, as remarked by one individual, "I hopped from rock to rock to get into the middle of the river which was extremely cool. But thinking about it, if I would have fell, I could have been gone. But I could see how the environment works, how it becomes something now. Then something can change. If you add something in, it can be a negative [or positive] thing." Though

this individual might not have known the exact velocity of the water, the temperature, or the pH, it certainly seemed that he was learning something, experiencing something, just by observing “the power of the river, it’s very cool,” he concluded. In this instance, however, the questions asked as part of this survey may not have captured the specific knowledge being obtained through outdoor play. Research suggests that differences in results do exist based on the types of questions – conceptual knowledge rather than factual knowledge (Connell, 1998; Rickinson, 2001). Future research likely should focus more on conceptual knowledge.

Gender, NES, and Environmental Knowledge

The topic of gender was important for this study. It is widely recognized that gender influences socialization and upbringing (Ärlemalm-Hagsér, 2006; Matthews, 1987). With respect to the outdoors, boys are often allowed to venture farther from home, while more protective attitudes and actions are taken toward girls (Matthews, 1987; Tranter & Pawson, 2001). Though there was no specific comparison of distance and gender as part of the study, one female did comment during the interview that, “we lived on a busy street and so I was kept from riding my bike too far down the street, kept from playing in the front yard.” It has been suggested that this effect tends to become less pronounced with age (Tranter & Pawson, 2001). Boys also tend to play outside more often and for longer periods of time than girls (Gleave, 2009). As part of this greater freedom among boys, previous research has presented some evidence that boys are more knowledgeable of their local environment than girls (Matthews, 1987; Rickinson, 2001). This study attempted to replicate previous findings that boys tend to be more outdoorsy, as well as have more general knowledge of their environment.

In the instances of NES and environmental knowledge scores, this was not the case. The mean difference in NES scores between males and females was .64, while the mean difference in environmental knowledge scores was .94. The effect size for NES and environmental knowledge was .06 and .18, respectively. The results indicated no significant differences existed between males and females on mean NES scores or mean environmental knowledge scores. These results do not suggest that differences might not have been present at younger ages; however, differences do not appear to exist at older ages in this study. This is not overly surprising, as research supports the reduction in observed differences of outdoor habits as boys and girls grow older (Tranter & Pawson, 2001). Future research therefore should perhaps focus on a younger audience. Surveying a younger population about outdoor habits and environmental knowledge may yield results more in line with previous research showing that gaps in knowledge and outdoor experiences do exist between males and females as young children.

One limitation of note is there was a substantial difference in sample size between males ($n = 108$) and females ($n = 274$), which was likely not representative of the 725 students enrolled in the course, and clearly not representative of the university population. Several considerations were made in an attempt to discern a reason for such a high participation rate by females. In the case that this sample was not representative of the particular biology course, gender among those enrolled was not able to be determined, as that field did not exist in the KU grade databases. Gender determination based on first name was considered. However, there were so many individuals from other cultures that the first name and gender wasn't always apparent. Thus, there was no effective way to determine a cause for such a high

participation rate among females in this case. However, research does offer some suggestion that females generally have a higher response rate on voluntary surveys than males (Smith, 2008).

Setting, NES, and Environmental Knowledge

Interest in the setting where an individual was raised during middle childhood stemmed from the association of learning with one's sense of place. Where a person lives is much more than just a geographic location. A sense of place also includes the broader ecological relationships and interactions of a given area (Lim & Barton, 2006). Urban development has traditionally left little room for play (Mainella *et al.*, 2011). At least in the sense of natural settings, this was confirmed by one individual who said, "there were parks around, but mostly built playgrounds. There were no woods." This is not particularly good news when it comes to levels of physical activity, and the previously discussed health benefits of increased outdoor play. Previous research has suggested a significant difference in the level of physical activity in natural environments between children from urban areas versus rural locations (Pretty *et al.*, 2009). The lack of outdoor experiences is in part due to lack of access to natural areas in urban locations, but also parents' safety concerns for their children (Pretty *et al.*, 2009; Valentine & McKendrick, 1997). The issue of safety did come up in one interview with the comment that, "[our] parents didn't think the neighborhood was the best so we weren't allowed to ride our bikes around alone."

Demographic information was collected asking individuals to identify the general environmental setting where they spent a majority of their middle childhood (urban, suburban,

rural, or farm) based on the zip code where they grew up. For the case of environmental knowledge, it was determined that a significant difference in means was present between individuals from urban and rural areas, with those from rural areas scoring higher by nearly two full points. In a broader context, a general gap in knowledge between these two groups, with urban students being outperformed by their non-urban peers, has been a topic of research for decades (Cohen *et al.*, 2006; Lacour & Tissington, 2011). Results from this study supports this knowledge gap, at least on the level of general environmental knowledge.

With regard to NES and an individual's home setting, there were no instances of significant differences in mean scores between groups. This is in contrast to a previously cited study (Pretty *et al.*, 2009) where individuals from an urban setting experienced reduced exposure to natural spaces versus their rural counterparts. Though no direct correlation was made with urban settings and the level of environmental knowledge, Pretty *et al.* (2009) did report that "less time spent outdoors in green spaces has resulted in drops in ecological knowledge and understanding." One possible explanation for no difference in mean NES scores is the large disparity in sample size between groups and the need for roughly the same sample size in statistical analyses (see Table 4-10). However, between the two groups, urban ($n = 63$, $M = 71.9$) and rural ($n = 66$, $M = 76.0$), there was a difference in mean NES scores, though the results were not statistically significant.

There were several limitations to this portion of the survey. The first was a definition of the different environments. When asked the environment of their home setting during middle childhood, they were asked also for the zip code of that location. It was not uncommon for there to be multiple respondents from the same zip code. The issue arose when analyzing

individual responses and how one individual identified their zip code (*e.g.* urban, suburban, rural, or farm) compared with another individual identifying with the same zip code. There was some discussion during the focus group about the possibility of simply selecting one [setting] for a particular zip code regardless of what was indicated on the survey. Here is another case of potential bias. By simply pairing an environment to a zip code, it would suggest that all parts of a zip code are in fact the same environment. Additionally, there could have been misunderstanding about identifying the environment based on what it is currently (*e.g.* suburban) versus what it might have been 10 or so years ago (*e.g.* rural). Additionally, with regard to setting, a connection might also have been made to the school [district] an individual attended. Schools “reflect the community,” commented one member of the focus group, adding, “How environmentally conscious is a community? And is that reflected in a particular school, district, or general community” through standards or extracurricular programs? A more direct discussion of education and standards is included in a later section.

A second potential limitation was the lack of a direct way to address family income. While this was not a demographic study of socioeconomic status, race/ethnicity, or otherwise, there is research to suggest differences in general academic achievement based on income and environmental setting. It certainly led to a lack of extended outdoor experiences for one respondent who commented that financial reasons kept their family from taking vacations. Alternately, this time at home, “being outside was like my vacation, that’s how I like to kind of, a place to be free in a sense, do what I want.”

An indirect method for estimating family income was based on a survey question about the type of housing where an individual spent a majority of their childhood (*e.g.* single-family

home, duplex, multi-unit apartment, etc.). This was not a reliable way to obtain this information as a disproportionate number of respondents indicated they lived in a single-family home ($n = 348$). As such, it was not possible to determine an accurate relationship between type of housing (*i.e.* single-family home, etc.) and setting of the home (*i.e.* urban, rural, etc.).

Related to home setting, the issue of parental concerns over safety came up in a couple of the interviews. While this study did not address specific safety concerns, future considerations might involve the inclusion of questions regarding supervised versus unsupervised outdoor play. While this would have added an additional dimension to the study, it was not the overall focus and would have increased the length of the survey.

Education, NES, and Environmental Knowledge

A majority of students in the United States are attending institutions of formal K-12 education. According to Education Secretary Arne Duncan, in 2012, the United States passed a “profound milestone,” graduating 80% of its students from high school (Layton, 2014). A part of this study took a closer look at formal education, particularly in science. For analysis purposes, statistical tests were limited to information about an individual’s high school and college science courses. Though data was collected about science at the elementary and middle school level, it was not included due in part to the lack of choice in science courses. Traditionally, there is also a lack of time spent on science at the elementary level. This lack of time spent on science at the elementary level is generally considered a result of NCLB and science not being included as part of high-stakes state assessments (Judson, 2013).

Once students enter high school, they are generally given a choice of which science classes to enroll in, so long as minimum requirements are met for graduation (*e.g.* Kansas requires a minimum of 3 credits of science). At the university level, depending on an individual's declared major, science offerings are even more flexible, from the variety of course offerings to the number of science courses required for graduation. A portion of this study asked respondents to identify the number of science courses they took at the high school and university level.

Based on the results of statistical tests, higher mean NES and environmental knowledge scores were found in individuals taking more science courses at the high school level. For the case of environmental knowledge, it stands to reason that more science education should lead to a broader understanding of science in general, and a greater understanding of the environment. With regard to NES, two explanations are offered, being careful not to offer a specific cause and effect of the higher mean NES scores for individuals taking more science classes. One explanation is that science classes on the whole spend more time outside than other courses; therefore, individuals taking more science classes are exposed to more authentic outdoor experiences as part of science instruction. An alternate explanation is that individuals with higher mean NES scores were more interested in science in the first place and therefore chose to take more science classes while in high school to explore this interest in more detail.

At the university level, the focus centered on individuals that took one or more science courses. Since this survey was completed by students in an undergraduate general biology course, all respondents should have indicated they had taken at least once science course at the university level. However, 10 individuals indicated that they had taken zero science courses.

This could have been a product of the wording of the question where respondents interpreted the item as asking whether or not they had completed a given course. Additionally, the undergraduate biology course is generally taken by incoming freshman, though certainly not always; yet 16 individuals responded with having taken six to ten science courses at the university level. Although it certainly is possible for this specific biology course to contain non-traditional students with substantial science backgrounds and having taken six to ten science courses, it seems unlikely. Nevertheless, both of these groups raised questions with regard to this item and were not included in the difference of means tests. They were also excluded due to the large difference in sample size between the other two groups (one science course, or two to five courses). One additional explanation arose during the focus group about a possible misunderstanding of the question, “Could they [the respondents] have viewed the question as asking about hours or credits rather than classes?” This was certainly a possibility, and as a result, those 16 responses were removed and the correlation calculation was repeated with NES and environmental knowledge. The result was an r -value of .126 ($r = .112$ with all responses).

Independent samples t -tests were calculated NES and environmental knowledge scores for the groups of individuals taking one science course or two to five courses at the university. A significant difference in means was found between the groups on the measure of environmental knowledge but not on NES scores. The same logic applies at the university level as at the high school level that more formal education would lead to increased environmental knowledge. There was a difference in mean NES scores of 1.04 between groups with individuals taking two to five science classes at the university level being higher.

As a means of determining what factors influence increased environmental knowledge, a correlation analysis was conducted between total science education (high school and university science courses combined) and environmental knowledge scores. Though an $r = .237$ correlation between total science education and environmental knowledge is considered weak, this correlation was more than double that of NES with environmental knowledge scores ($r = .112$).

A separate test was run on the correlation between level of high school science and university science. There was no significant relationship between the number of high school and university science courses. The number of science courses taken at the university level is more determined by how long an individual has been out of high school and in college. A future study should include more information about individuals and their educational backgrounds, specifically their association with class level (*i.e.* freshman, sophomore, etc.). It should be noted that three separate ANOVA tests were run to determine if there was a difference in means of NES scores, mean environmental knowledge, and the number of classes based on the identified undergraduate major. There were no significant differences on any of the three tests. This is in large part due to the vast differences in sample size as those identifying as science majors ($n = 34$), engineering majors ($n = 5$), and math majors ($n = 2$), and those identifying as other ($n = 341$). Other majors identified ranged from education, to business, to pre-law. It could also be argued that this test was inappropriate due to such small samples sizes between some of the groups (Boos & Hughes-Oliver, 2000).

Free-choice Learning, NES, and Environmental Knowledge

The Institute for Innovative Learning defines free-choice learning as that learning “which most typically occurs while people visit museums or other cultural institutions, watch television, read a newspaper, talk with friends, attend a play, or surf the Internet” (Moursund, 2007). This area of learning must be acknowledged as an important component of the overall education system. In fact, organizations such as the National Science Foundation (NSF) and the Bill and Melinda Gates Foundation invest millions of dollars annually on such informal learning (Moursund, 2007). Information on an individual’s engagement with free-choice learning was collected via items in the NES in order to acknowledge that factual information is obtained from sources other than formal education.

The unique thing about informal or free-choice learning is the ability for an individual to pick and choose the level of involvement based on interest. Yet there are critics of these types of experiences. Some critics of zoos, for example, argue there are not enough opportunities for ‘true freedom’ since zoos can generally control what animals are on display (Khalil, 2014). However, the game is changing and now more places are beginning to plan and design exhibits promoting more authentic interactions that are seen as critical to nature experiences (Heimlich & Horr, 2010; Perdue *et al.*, 2012). Khalil (2014) cited a specific example, Hamill Family Play Zoo, where the main goal is to “foster positive attitudes toward nature instead of imparting specific knowledge or facts.” Some zoos and cultural facilities have even incorporated citizen science programs and urban community projects as a way to engage visitors and expand beyond their physical boundaries (Cohn, 2008; Khalil, 2014).

Experiences with free-choice learning were sampled in this study through the inclusion of three items as part of the NES (see Table 5-1). These items were intended to gauge the level of involvement of individuals engaged in free-choice learning. The results of a correlation analysis between free-choice learning and environmental knowledge showed almost no correlation ($r = .006$), possibly due to the small number of items.

Free-choice Learning Items
My family took trips to the zoo or botanical gardens.
I participated in multi-day trips to natural areas.
I took camping trips with my family or friends.

Table 5-1 – Three free-choice learning items included in the NES.

Future considerations for measuring engagement in free-choice learning should focus on the inclusion of a greater variety of experiences. Suggestions made for future survey items include trips to state or national parks, trips to museums, time spent at nature-based day camps, and time spent engaging with nature related media (television shows, radio programming, magazines, etc.).

Final Conclusions and Future Directions

For the overall nature of the study, questions were raised during the focus group regarding the demographic information collected. These questions were generally associated with the environmental settings investigated (*e.g.* urban, suburban, rural, and farm). However, there could also have been some confusion over the definitions of environmental setting. For example, what environmental setting does an individual identify with when coming from a home in a small town with nearby farmland versus a large farm in close proximity to a large metropolitan area? Additionally, what if an individual spent summers in one location (*i.e.* on a farm), and lived in the city during the school year? There also exists the possibility that lower income individuals may not have the same access as those with higher income, such as access

to free-choice learning experiences or formal post-secondary education. Generally speaking, there has been some research to suggest that those children from lower income families tend to have fewer outdoor experiences. For this reason, more detailed family socioeconomic data should be collected in the future.

There is some concern over the generalizability of this study. The sample size was taken from a single undergraduate biology course at a single university. While the course was intentionally selected for the broad demographics of its members, the demographics of the sample were not entirely representative of the university as a whole. It was also assumed, because of the specific course where the survey was administered, that individuals were all nearly the same age (late teens, underclassmen), though this specific question was not asked as part of the study. This concern was raised by the focus group with the suggestion of also including age, or class level (freshman, sophomore, etc.) as identifying characteristics in the demographic data collected. This additional information might have also helped to clarify some of the concerns related to the number of science courses an individual had taken at the university level. This study therefore perhaps has a limited generalizability of the results to a broader population. Additionally, future consideration should be given to the time lapse between the time of the experience and the time of the survey or other evaluation. As previously mentioned, the farther removed one is from an experience, the less accurate the memory of that experience. If the focus on outdoor experiences is on middle childhood, then individuals closer to the age of middle childhood should be asked about the outdoor play habits.

In general, the results of this study, although not strong, were in the expected direction suggesting a possible relationship between outdoor experiences during middle childhood and an adult's knowledge of the environment. See Table 5-2 for a brief review of the results. Several considerations for future research have been presented in this chapter. Looking toward the future, research must continue to address and ask questions to further the understanding of the relationship between humans and their environment. With so much discussion around environmental issues such as extreme weather events, air and water quality, and soil degradation for agricultural purposes, perhaps this is the time to address a more intimate relationship with the environment that supports us on a daily basis. Children must be allowed to explore the outdoors, develop a sense of place, and gain an appreciation for their world.

Outcome Measure	Key Findings
<i>H₁: There is no significant correlation between an individual's NES score for outdoorsiness and a higher score of environmental knowledge.</i>	There was a significant positive relationship between outdoorsiness and environmental knowledge.
<i>H₂: There is no significant difference in mean NES scores between males and females.</i>	There was no difference between males and females on NES or environmental knowledge.
<i>H₃: There is no significant difference of NES scores among individuals raised in various settings (urban, suburban, rural, and farm).</i>	There was no significant difference NES scores based on participants home environments. Participants from urban environments scored significantly lower on environmental knowledge than those from rural environments.
<i>H₄: There is no significant difference in mean environmental knowledge scores between individuals taking more science courses and fewer science courses during formal education (high school and university).</i>	Participants taking four or more science specific courses in high school scored significantly higher than those who took fewer than four classes. Participants taking two to five science courses at the university level scored significantly higher than those who had fewer courses.
<i>H₅: There is no significant correlation between an individual's environmental knowledge score and their free-choice learning experiences (a subset of NES score).</i>	There was a significantly positive correlation with free-choice learning and NES scores. There was no significant relationship with environmental knowledge scores and free-choice learning.

Table 5-2 – Summary of key findings.

Impacts on Science (Environmental) Education

While the statistical results of the quantitative portion of this study may not be generalizable to a broader population at-large, there were still some interesting findings that could be used to advance instructional practice around science education in general. One of the key findings of this study is that children are not playing outside very often, as indicated by a very generalized interpretation of the NES scores. This finding was supported by the one-on-one interviews where a number of interviewees referenced not really enjoying being outdoors, or being distracted by other things such as increased access to a wide range of electronic devices and media. There were also a number of references during the interviews to not having a lot of free time to be left to participate in unstructured outdoor activities. This finding is also supported by previous research cited in chapter 2, *Research Context*.

One key take away from this study, research context included, is that we need to get our children outside, and the earlier the better. There are too many positive benefits of unstructured (and structured) outdoor playtime. Whether it is just playing organized sports outdoors or being allowed the freedom and opportunity to explore a local park, children need to be outdoors. It leads to better overall health, better social skills when interacting with other children, and has been shown to increase critical-thinking skills, communication and collaboration among individuals, and general creativity and imagination. These are all things that we should value as a society moving forward in the 21st Century. In fact, it is those skills – critical-thinking, communication and collaboration, and creativity – in which schools and informal education settings alike are striving to promote. These are the skills that our children

need not only to be college and career ready, but also to be productive, contributing citizens in a global society. Children can learn and practice these skills outdoors.

Speaking a little more specifically to formal education and the impact of this study, I would like to take a closer look in future research at the effect of outdoor experiences, structured and unstructured, on children diagnosed with ADHD and their success and performance in science, and also school in general. Do they have fewer instances of misbehavior? Do they tend to score higher on various forms of common assessment? Do they show more academic gain over time than those students not exposed to outdoor environments?

Moving this idea to an even broader context of science education, are students that are exposed to the outdoors better able to articulate the interconnectedness of various science concepts or transfer some of their critical-thinking skills into other content areas more effectively than those students not exposed to the outdoors? There has been a strong push in the last decade or so of teaching science through more of a systems approach rather than discrete facts about a particular science discipline. Being exposed to the outdoors offers students a chance to engage in the authentic exploration of their local environment. Not only does this add depth and context to the facts they would learn in a traditional education setting of lecture or very structured, procedure-based science labs, but also allows the student to witness real interactions and cause and effect relationships. This systems-based education model at a local level or at broader scales, can also add to an individual's sense of place about the local environment and how their decisions can impact the broader society. The information and research cited in *The Framework for K-12 Science Education* (used to write the Next

Generation Science Standards) has acknowledged this reality and crafted NGSS to reflect such ideas.

The overall goal of NGSS is to engage students in authentic explorations of their world, beginning with asking questions and defining problems relevant to a given topic, but then analyzing these questions and problems through systems and system models. While most of the ideas presented in *The Framework* and NGSS documents are not new, it is the intentionality they highlight that is leading to a shift in thinking and new instructional strategies. Classrooms and education in general are no longer able to settle for rote memorization and fact regurgitation. They are shifting to build and promote a culture of inquiry, and culture of thinking, where students are challenged and motivated by problems and questions that are relevant to their lives now and into the future.

There is no better place to explore and engage in the process of science than the unpredictable, unstructured arena of the outdoors. However, experiences alone do not lead to learning. Individuals have to be allowed to process and think about their experiences and discuss those experiences with others. They have to be allowed to try different things based on those experiences and the experiences of others. This is the process of metacognition, and making thinking visible, a process that has often been left out of the learning cycle. This was a process that also was left out of this study, albeit it not intentionally.

Metacognition is a process that is often overlooked, but also difficult to measure or assess when considered. However, it might be one of the most important processes in the learning cycle. Through these outdoor experiences, it is the discussion and thinking about their thought processes that leads individuals to a deeper understanding of their experiences. The

systems-based model of science education, when done well, takes metacognition into account and allows students to fully engage in their understanding of their experiences. Metacognition offers individuals a chance to share experiences and learn from them, offering unique insights into their world of understanding and processing. This is absolutely critical when trying to grasp any degree of understanding about a topic as big as the global environment. If we want to raise a generation of students that appreciates and cares for their world, the ideas just discussed must be taken into account. As an ancient proverb is often quoted, "Treat the earth well: it was not given to you by your parents, it was loaned to you by your children. We do not inherit the Earth from our Ancestors, we borrow it from our Children."

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Appendix A – Childhood Outdoor Experiences Interview Questions

Date: September 01, 2014

Time: 6:30pm

Location: Over-the-phone

Length: 21 minutes

Interviewee (Gender): Female

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: From a very young age I have always had a great appreciation for the outdoors, I think because of that, I am more concerned about how I treat the environment. I'm not sure how to respond about learning, but I certainly think I learned things while I was outside. I don't know that I would say I did one because of the other. Does that make sense?

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: I tried out different sports, like indoor basketball and outdoor soccer. I didn't really play any for very long. It just wasn't my thing.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: I was in Girl Scouts for only a couple years. I was also on a few basketball and dodgeball teams at the YMCA, but that was about it.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: When I was younger, I remember I went to a camp called Kanakuk for 2 weeks one summer where we did many outdoor activities. We played sports, games, camped, and spent time on the lake. It was a good time.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: We were pretty lucky. My family vacationed almost every summer. We often went to the beach or visited our lake house in Minnesota. Our vacations definitely were more planned around being outdoors. We didn't always have a plan in mind or specific activities planned, but we were doing things outside.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: As a child I lived in a suburban area surrounded by woods where I would play a lot. Not far from our house also was a Nature center with trails and ponds. I played in the woods with my neighbors almost every day. Sometimes we would build little forts or climb trees. Sometimes we just went walking through the woods to see what we could find. It was fun just walking around and being away from the house.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: I think the only restrictions I had would be weather or if I was distracted by video games or TV. I'm not sure how often that happened, but there weren't really any things keeping me from being outside.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: Growing up in Kansas was hard because I am such an outdoorsy person. It's not the easiest place to live for someone that likes being outside a lot, or likes different environments. But every summer I was fortunate enough to go to Minnesota. We got to play in the woods, walk around the lake. I still look forward to it every day. I will never forget the time we went hiking and jumped off a cliff into a lake. There aren't a lot of place around here where you can do something like that. It made me feel alive and I love being surrounded by nature.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: I don't think so. Thank you.

Appendix B – Childhood Outdoor Experiences Interview Questions

Date: September 04, 2014

Time: 3:45pm

Location: Over-the-phone

Length: 23 minutes

Interviewee (Gender): Female

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: The first one, I lived out in the country. The only way you know how to deal with certain animals is if you are around them. Like snakes. The more time I spent outside, the more I learned. I'm not afraid of snakes anymore the more I was around them. I know what snakes are actually poisonous. I never set down and was taught this snake is poisonous so don't touch it. This one is OK. I was never actually taught the knowledge I just know it, from being outside.

I wasn't afraid of the outdoors. I'm trying to think, like. Being outdoors, playing outside, I stayed active. I enjoy going outside now that I'm older. Sitting along, isn't very appealing, isn't as fun. So I like being outdoors, playing outside.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: I played softball since I was like five. And then in middle/high school, basketball. That kind of thing. Didn't do any clubs or anything.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: [My] sisters were in 4H. I was never in 4H. I tagged along a few times. But never officially in it. No scouts. I had friends that were, but I never was. I played summer ball, so we traveled a lot. Never really had time to join anything. I was always busy with my sports, so I didn't really have time to do anything besides softball basically. There was not a lot of time for

free-time. Dad was the coach, so even when we weren't playing softball, we were always practicing.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: Like I said before, we didn't really have much free time growing up. There was always something going on, practice or something.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: We went to Florida, went to the beach a few times. We would travel to visit family. When we visited family in Kansas, went to the race track every now and then.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: I'm from Arkansas and we lived near the woods. After elementary school [10th grade] we moved to Kansas. We lived out in the country, near farmland. There was a fence, it said no trespassing, but you know, you never follow the directions. That was right behind our house. We were in a neighborhood. A bunch of houses and stuff, but not really in town. Once you got in the neighborhood, kind of in the back section, there were woods all around. There was a small gathering of houses, not really suburbia. We were far enough outside of town that we still had to drive 30 minutes to get to the store and other places.

Like I said, there were woods near our house so we would often wonder around. We climbed trees sometimes.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: When I'm sick. My parents wouldn't let me go outside. We usually had chores and sometimes that would take a good portion of the day. We had classes (school) during the academic year. I was trying to think if there was anything else. I think that's it. Next question.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: You want an experience that was outside? Growing up, as a family, we spent time outside. Dad would BBQ and we'd hang out. Usually during the day dad would be mowing the grass. Growing up we were always doing family stuff outside. Like play in the woods. My sisters and I would be outside, we'd get ticks all over us. But that's the usual thing. Most of my experiences outside were with my family even if it was just hanging out at a picnic or something.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: What are you doing with this research? How are you using it? Are they creating an outdoor class? I wish we would have spent more time outside in school. I think it would be great if we were allowed more time in middle and high school.

Interviewer: The research is part of my dissertation and will be used to provide information to schools and districts that may be interested in exploring ways to get students outdoors more often. I wish every school would have an outdoor classroom and spend time outdoors, not just in science.

Appendix C – Childhood Outdoor Experiences Interview Questions

Date: September 02, 2014

Time: 4:25 pm

Location: Over-the-phone

Length: 29 minutes

Interviewee (Gender): Male

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: I'm not sure being outside directly impacted my knowledge of the environment, but I would say that the more I learned, the more I wanted to be outside. Growing up I was always afraid of storms. The flashes of lightning and loud claps of thunder always scared me. I even remember someone telling me that if I was standing outside of a door with the door open during the middle of a storm that lightning would strike. Not sure where anything like that came from, I just remember it terrified me for a long time. But the older I got, the more I learned and realize that lightning and storms were dangerous, but that they wouldn't really hurt you if you were just leaning out a door. Since then I have come to respect nature and appreciate the power of it.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: I played baseball and basketball from a very young age. I remember playing t-ball, then moving up to machine pitch, coach pitch, and then kid pitch. I played every summer growing up until I graduated. I still play softball now. I played basketball all the way through high school as well, but mostly just club stuff after middle school. I think I played indoor soccer for a few years but never really liked that much.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: I was in Boy Scouts for a number of years growing up. I remember I made it through Webelos, but then stopped. Our troop was really boring. My cousin didn't live too far from us but he was in a different troop. They went camping all the time, went on trips outdoors, took a flying lesson, all sorts of stuff. We didn't do anything like that. The only big even type thing I remember doing we the pine wood derby races. I don't think we ever went camping a single time now that I think back about it.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: Oh yeah, I went to the same summer camp for like six years in a row at the local park. It was all day, every week day, and the whole camp was outside. We would go from session to session all over the park with different activities at each one. We learned to fish, canoe, and archery. Lots of nature related crafts, building things out of sticks, drawing things in nature. It was all about being outdoors and being active. We got to go swimming every day. The only thing can kept us inside was if the weather was bad. I remember a few bad storms where we had to take cover in the hallways of a local shelter house, but nothing bad ever really happened. Just lots of rain and hail sometimes.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: We didn't really take many vacations. The only one I remember before I got into high school was a week-long trip to Colorado. We stayed in Colorado Springs for a week and did a lot of the tourist stuff, Cave of the Winds, Garden of the Gods, that stuff. I'm not sure we actually went on a hike in the mountains anywhere. In high school I do remember taking two trips with my grandparents and a cousin, once to Colorado and once to Wyoming, to the national parks. Those were always fun trips. We didn't do outdoor camping because they had a motor home, but we did go on hikes through the mountains to the different lakes and stuff.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: Probably a medium-sized town. We lived in a developing neighborhood so there was a dead-end at one end of the street. Some friends across the street had a four-wheeler so we used to ride that around a lot. We would always be playing in the streets. There were probably 12 kids on our block within just a few years of each other. We play baseball, football,

kick-the-can, and hide-and-seek at night. It was a new neighborhood so no trees for tree houses.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: There wasn't really much that kept me inside. I went through a computer game phase for a while, but that didn't last long. During the summer especially, we were outside all the time. Even in the rain, as long as there wasn't lightning. We would ride our bikes along the curb in the rain and let the water fly up. The only thing I can think of too is if I was in trouble, or sick I guess.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: I guess there was a fishing trip with my grandparents one Saturday. We had been out all morning and didn't really catch up. Grandpa was putting the boat away and I was just dragging my pole along the side of the dock. Grandma said I wasn't going to catch anything and that I was wasting my time. Sure enough, not five minutes later there was a tug on the line and I pulled up a tiny little blue gill. She about fell into the water she was laughing so hard. I remember that being pretty fun. They were always really good about getting me outside and taking me fishing on the boat on the weekends. I remember not being very excited about being dragged out of bed at 5am to load up and drive about an hour away. It was fun the first couple of times until I realized that I enjoyed sleep.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: I don't think there is anything specific. I just remember being outside all the time. My parents were never really out there with me, but they just let me roam. As long as I was within ear shot, which wasn't quite all the time, they didn't really mind.

Appendix D – Childhood Outdoor Experiences Interview Questions

Date: September 01, 2014

Time: 3:45pm

Location: Over-the-phone

Length: 23 minutes

Interviewee (Gender): Female

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: I have a certain love for the outdoors, as well as a heightened excitement for adventure and exploration. I think I learned a lot while being outside, but my experience might be a little different. I would travel with my father who does field work in geology, so we would travel a lot for his work.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: I played outdoor soccer, indoor soccer, and indoor tennis. I did that for a number of years, but that was about all. It mostly depended on the season, but I really enjoyed soccer and would play that several months out of the year.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: I participated in Girl Scouts from second grade to about fourth grade. We did a few things outside from time to time but I wouldn't say it was a focus at all. I also participated in L.I.N.K. through my church, which helped feed the homeless every few Sundays at other local churches. That was a good experience.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: Although I did not participate because of age, I accompanied my father to his geology field camp in Colorado. While we were in the field, we stayed in cabins among the mountains and I was able to explore and interact with aspiring college geologists. It was fun to interact with all the students and see how science worked.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: My family vacationed every so often, most times in the U.S. to Colorado, Florida, Seattle, Wyoming, Arizona, Indiana, Texas, New York. Many of those places were for my father's geology/paleontology work (out in the wilderness). We also traveled to the city and countryside of Greece and its many islands, as well as to London and Wales, also for my father's job. There I went along with him to explore beaches and the local colleges.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: Grew up most of my life in Kansas, so with various nature parks and a lake close by, I had a good mix of nature and urbanization. The lake was a close drive and allowed easy access to trails and hiking areas.

We played in the woods in a local nature trail, and I explored deep within it with friends. For my friends who lived close, we would play in each other's back yards and in the near cul-de-sac, ride bikes, hide and seek. Also, we took many walks to local parks and friends' homes. We were outside quite a bit.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: Living on a semi-busy street, I was kept from riding my bike too far down the street. Sometimes I was kept from playing in the front yard. But other than that, I didn't have any real rules keeping me inside or not exploring.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: In Wyoming while on a work trip with my father, we stayed in a little community home. Outside was a chain-link fenced in place for children to play. My mother took me over

there one afternoon, surrounded by wilderness with just a fence to block out some of the views of the mountains. As I was pushed in a swing, two wolves came right up to the fence, nuzzled each other, and watched me play. This sparked excitement within me, and made me feel comfortable in wide open, nature heavy places. It was pretty special for us to see that.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: None that I can thin of. Thank you.

Appendix E – Childhood Outdoor Experiences Interview Questions

Date: August 31, 2014

Time: 4:25pm

Location: Over-the-phone

Length: 19 minutes

Interviewee (Gender): Female

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: Yeah, I'd say I learned things. I'm not sure I could tell you that I went outside to learn them, but just exploring, even around my own yard, I would say I discovered things that I might not have some other way. I loved playing in the outdoors and when I grew up loving and respecting nature and all of its creatures it shaped me to me an extreme environmentalist now.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: I started playing soccer and softball at a young age but quickly quit soccer and stuck with softball for a few more years. We'd play tournaments on the weekends, and obviously, that was outside stuff.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: I was in the YMCA afterschool for a few years. Then sometimes in the winter and over the summer I was in clubs because my parents didn't want me to stay home alone.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: I was in a summer camp for years and went to sleep away camps. My summer camp, camp Evergreen, did a bunch of nature hikes and Phantom Lake. My sleep away camp

was very focused on preserving nature. We all had a really good time and just enjoyed being outside, especially during the summer.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: When I went on vacations we usually went to really touristy areas such as Disney World or Washington D.C. We went to all the big attractions, and there were usually lots of people. It wasn't really nature driven for the most part. If we did, we went to my family's lake house and we had nature in mind and would spend time in the woods, camping and fishing. Camping was always fun.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: Where I grew up was very close to the city of Chicago. We had lots of parks and some nature trails. Most of the parks had at least a play structure or two, some trees. When I was little my best friend had a backyard and we would dig up worms and look at different plants. I remember once, he also had a birthday party where his family hid different rocks and minerals around and the ones we found we got to keep. Now it seems a little funny, but back then it was fun.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: I think just a lack of really having a lot of open nature, open fields and stuff, around to explore was a big reason. There weren't a lot of places we could just go and explore. All we really had was backyards besides at my lake house, so that's where we stayed. I don't remember any real rules we had about staying away from certain areas or anything like that.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: I have always loved nature and I think having parents who were extremely concerned with the environment shaped my views.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: Not that I can think of at the moment. This was interesting. Thank you.

Appendix F – Childhood Outdoor Experiences Interview Questions

Date: September 02, 2014

Time: 4:30pm

Location: Over-the-phone

Length: 25 minutes

Interviewee (Gender): Female

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: I think that even though I had good experiences at Girl Scout camps I was always scared of bugs and did not like the outdoors. I'm not sure I took the time to learn about them, I just didn't like them. I was older and traveled a little bit, I think that when I went to Yellowstone I realized that nature really isn't all that bad or scary, so it gave me a better appreciation of the outdoors and the environment. I've learned a lot since then, but not sure I remember that much from childhood. From being in the park [Yellowstone] I have explored, talked to people, and learned that we need to take care of the environment so that future generations can go to parks and ride bikes without health or safety concerns.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: I played slow-pitch softball from kindergarten to freshman year of high school. It was not competitive though. I started with t-ball. I also tried soccer, but hated it. I also took swimming lessons for all of middle childhood. I love swimming. Most of my swimming lessons were inside.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: I was in Girl Scouts my whole life. I had good experiences in Girl Scouts. I met a lot of friends and have a lot of memories of our campouts and things like that. My mom was my

leader so she helped me have a good experience. And my family has been doing scouting for a long time. I won first place at the state fair in the Girl Scout tent one time for cookies that I made. I am glad I got to be in Girl Scouts.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: I went to some day camps through Girl Scouts. I liked the activities we did, the campfires, and the songs we sang. My normal camping experience was in an air-conditioned/heated, running water, building. I only stayed out in a tent once when I went fishing with my dad. It's kind of funny, but even though it was in Kansas I was afraid of bears. I liked being outside but camping wasn't really my thing.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: My family usually traveled to rural communities. Mostly in Western Kansas, a lot of time to visit family or friends. We also went to larger cities, to see the sights and sometimes go shopping. Mostly our trips were to visit family, but sometimes we would go on trips just to travel. Some of our trips were to see national monuments and landmarks such as Mt. Rushmore, and Disney World. Those were good trips, but some had really long drives. That part wasn't much fun.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: I grew up in a city. I had a ditch by my house that led to a creek. I did not go to the creek very often though. There were three parks by my house that were all big and had lots of playground equipment, volleyball courts, and open fields.

I did not like the outdoors very much as a child. I played at the park, rode my bike, and played in the ditch a lot though. I also liked to play in the mud under our neighbor's tree. I had fun outside but didn't really do it very often.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: My parents wouldn't let me be out after dark. My parents didn't want me going to the far part of the park without someone with me when I was little. Other than that, there weren't really anything that kept me from being outside except if I didn't want to. I think I was very fortunate to live in a safe neighborhood where I could go to the park and ride my bike.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: I have worked at Yellowstone National Park for two summers now and that has given me a greater appreciation for nature and the environment. I was a little hesitant to go there because I really did not like the outdoors as a child, but now I love them. I would still rather live in a city, but I believe it is important to preserve and visit nature.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: Nope.

Appendix G – Childhood Outdoor Experiences Interview Questions

Date: September 04, 2014

Time: 4:40pm

Location: Over-the-phone

Length: 31 minutes

Interviewee (Gender): Female

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: A little bit of both. Knowing more made me more curious which led me to the outside. Being outside as a kid made me question a lot of things. I can't tell you what, but it made me more knowledgeable. I don't really know how else to explain it. I felt like I learned more outside.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: As a child, I mostly played indoor sports. I actually on participated in gymnastics and dance. Those were the only two. Some days I would practice outside in the yard when I got home. I would use outdoors as a gym, but I never did outdoor sports.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: I think I was at the brownie level for girl scouts and then stopped after that. I don't really remember. My mom didn't like the person running it, and it was disorganized. Brownies wasn't really a thing. There weren't very many people in it, and [I] wasn't in it for very long, so I don't remember totally. It wasn't really my choice.

One time [in scouts] we went to (Illinois) on the great river road, to a lodge, an overnight camp for three days. Parents went with their kids. That was in kindergarten or first grade I think. We

had a good time, but that was really the only outdoor thing I can remember from scouts. I wasn't in it very long.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: I went to Camp Ondessonk which was a week-long overnight camp that was all outside for two years, in southern Illinois. I loved it! Shawnee National forest of Southern Illinois. There was even a part where you got to pick which place you slept, you could stay in a cave if you wanted to. There are bunks, but only three sides to the houses we stayed in, and there were mosquito nets. I don't remember it being too bad, but it's not like being in Colorado where there are so many mosquitos.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: They were generally planned with nature in mind. We could go camping, kayaking, canoeing, and hiking. We went to Missouri and Colorado, to be outdoors and go hiking. My Dad was a big hiker and he would go on big hiking trips for two weeks every summer out west. Him and my mom had a big influence. We never opposed the trips. Sometimes we would bring friends and they had never been. Sometimes we would maybe three times a year. I remember one trip, hiking in Colorado six years ago for two weeks. You bring a big back pack, less weight as possible, basically set up a tent and hang out. We didn't eat very well for two weeks.

It wasn't two weeks in the same area. We would do four to five day hikes in one national park, drive, then do another four to five day hike in a different area. We've been to Glacier National Park [in Montana]. Dad goes to Glacier almost every year. He's hiked everywhere. It's his top place to go.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: Yes. I am from Southern Illinois and there was tons of nature around us. It was a suburb out of St. Louis. There were lots of parks around, but nothing too big. They were mainly city parks, with play equipment, kind of. When we camped we usually went to Missouri or Southern Illinois. We had a mix of urban since we were right out of the city.

Sometimes we built forts, or just ran around. Some days mostly during the spring and summer, my mom would pack bags and we would do “day hikes” around our house. It was a nice way just to get out of the house.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: There were times when my mom did not want us to explore our neighborhood alone, mainly safety concerns. It was a very diverse city. My parents didn’t always think the neighborhood was the best so we generally weren’t allowed to ride our bikes around alone.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: Hiking in Colorado certainly shaped my views on nature. My dad also hikes around the country as a hobby, and that has shaped my opinion on nature too. I just remember being in Colorado [out west] for the first time. Driving out of Kansas and seeing the mountains for the first time. It was so cool. Being from the Midwest, you just don’t see things like that. I could breathe out west. I liked being on the trails. While hiking we would see lots of elk, but no bears. We even saw moose once in a while but it was kind of rare to see moose and bears. I remember a trip to Rocky Mountain National Park, that was more populated. Lots of people, not as much peace and quiet, but we did see lots of elk.

One trip to the Tetons, barely saw eagles. Dad has traveled there in the past and seen them all over the place. But his most recent trip two years ago, it was weird, he didn’t see much. It depends.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: I just remember always being outside. Being outside, my parents forced [us] to get fresh air and that has made me appreciate having time outside rather than inside. I cannot be inside for too much time because it makes me feel cooped up.

Appendix H – Childhood Outdoor Experiences Interview Questions

Date: September 07, 2014

Time: 9:35am

Location: Over-the-phone

Length: 36 minutes

Interviewee (Gender): Male

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: I know what you're saying. I never had the experience, the more I learn, the more I. I was never like a science kid or something like that. So it's not like I learned something, I wanted to go out and experience it. I experienced it was like, OK. So If I was a better biology kid or something, it might have been like let's go see this, but I was never like that.

I think it's a matter of awareness. I mean, if you're never out there, you don't know what you're, you know, you have no experiences to base it off of.

You have to experience it first-hand. And you, sit through a lecture, you only get a snap shot, the one the person is giving you. You still have to funnel it through you own experience. Um, so yeah, grew up camping, outdoor experiences. Experience the dew in the grass in the morning. You know, suffer through rainstorms, or something like that.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: Outdoors, we didn't start playing football until 7th and 8th grade. I had one year of soccer, that was around 3rd grade, and I didn't enjoy that. It was cold and wet, and not that enjoyable. Mostly baseball was outdoors, every year, that was great. There used to be this great ballpark. This park had all these woods right behind it, all these trails. And so when I wasn't playing, and watching my brothers play, we'd go, we'd be playing sports, we'd be running through the woods. It was a park in town, but kind of secluded in the woods. We'd see

bugs, look for bugs, and run through the trees. I always liked playing, but sometimes it was just as fun to be at the park and allowed to run around while my brothers were playing.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: I was in scouts for a while. We would go camping from time to time, but that was about it. I didn't say in it for very long.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: No, they never sent me to camps or anything like that. I had a bow and arrow, we had horses, we had our own little camp in, barn. We'd have kids over to the house, ride horses.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: The earlier on, we were outside, then it switched after that. So our next vacations were back in DC, New York. That was when the rest of the family was getting older, so. I don't think we did as much. We did a lot after that, a lot of cheap, family vacations. Travel America.

Oh, One of the best ones, packed in the family car, going up the winding hills, I think we were trying to go to Cheyenne, WY, I think we were going to the mountains south of there. Um, coming from Rushmore, that might be the same trip. I guess it was a two-lane road. We were all stuck in the family station wagon, fighting each other, or whatever. My dad had enough. He stopped the car, and lined us all up along the side of the road, spanked us. Pretty good. Meanwhile, there's a stream of cars going all along the road, both ways. And my dad's just popping away at our butts. You know, if that happened today, they'd be all across the state looking for us.

When we were kids, we went to the lake all the time, for a couple summers. My cousin's parents, they owned a cabin, or a house on a lake. It was kind of a crap lake, it wasn't really ever very deep. We would go half across the lake, and it was only like five feet deep, or something like that, six feet deep. But we would spend every Sunday out there. And that was, I can't imagine giving up all those Sundays, but it was just part of our routine. We come back from mass, load up, head out there, and we were there all afternoon, in the early evening. Swimming, skiing, whatever else. Mud fights. Dig up the mud from the bottom, sling it at each other. We'd turn over a little raft, put it up over your head, you have a little free space, kind of like a little fort.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: I grew up out in the country, a little bit on the fringe. We had 10 acres behind the house. We had horses, stuff like that. A lot of the outdoors was riding the horses.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: None really, just bad weather mostly. We really like being outside, on the horses and in the fields.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: The best, a trip I remember that was most memorable, from being a kid, a camping trip. Me and my brother and my dad saddled up on a western saddle with a big 'ol tent on the back and side of a horse. So we all saddled up, and went up, not that far. I was only about five years old. It was one of these enormous army style canvas tents, it was more about like the size of a punching bag, with the heavy wooden stakes. I mean that thing probably weighed 50 to 100 pounds. And then it was me in the front of the saddle, my brother in the back of the saddle, and my dad in the saddle. And then the bag on the back. I'm sure Benji the horse loved that. So we went just a little ways. Put up tent, it seems like for all the work we did, we should have gone further, somewhere. But this was a pasture, we could leave the horse out there and stuff like that. So we put the tent up, in the middle of the night, it was storming so bad, water coming in the tent, and everything else. Little Benji out in the middle, unprotected, I think she was just tied up somewhere. My dad had enough of it. He grew up out in the country, so was not a big hiking, camping type. He was out in the country anyway. You know, that's what people did, go out in the country. So it wasn't like this is unique, or whatever. But he'd had enough. At about 3am, he decided we'd pack up the whole tent, load up the horse and ride back, in the middle of the rain storm. He had enough of it. So I remember that. That was our hiking, camping trip, or one of them. But we did a lot of other stuff. Mostly we did like car camping. I think we went down to the Bennett Springs area. Pulling the pop up camper behind, then we went all the way up to Mt. Rushmore area, the Black Hills, pulling the pop-up camper. So all those, I was the youngest, so I was only about 5, 6 something like that.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: One more trip I remember, I guess. We were going back to DC, Virginia, all that. So this is the trip of all trips. This is when I say we're not camping anymore. First of all, we drive up to Iowa to borrow my cousin's van. They have a van, we didn't have a van. We get up there, we switch vehicles. They have a van, they have 7 kids. My dad forgets his underwear. And for whatever reason he borrows my uncles underwear. Yeah, he doesn't just buy new underwear, he borrows it. He's cheap. We grew up cheap. We drive half-way across the United States, and we're staying, we get into Pennsylvania, we're driving in, I think it's Harrisburg. We get in late, so we're driving up and down the strip. Looking for a hotel room. There's plenty of vacancies, but my dad's always looking for one cheaper. But I think the cheapest, I remember looking at this, and there was like one for \$19.95, or something like that, or whatever, and it's just like maybe we can find one for 15. And so we don't find anything, and then the \$19.95 one is gone as well. So we'll all there, all of us, the six of us, 2 adults, for kids, and my grandma, in the van. And we decide, or dad decides, that we're going to park in the Sheraton parking lot (it was the nicest of the nice hotels back then), whatever, and just sleep in the van. Yeah, 7 of us, in the van. In the middle of summer. So we make it, we get about half-way through the night and it gets pretty hot, you know. It's got those little pop-out windows that open about 2 inches, that's about it. So we just open the door all the way. Three of us sprawl out on the grass in the parking lot at the Sheraton, and fall asleep. We sleep part of the night, and I remember a tour bus that pulls up in the middle of the night somewhere near our van, and starts unloading in the middle of the night, and people going into the Sheraton. And they're like, looking out at us, sleeping in the grass, in the middle of the Sheraton parking lot. So we camped in the Sheraton parking lot. We got up the next morning and went on, and that was it.

Appendix I – Childhood Outdoor Experiences Interview Questions

Date: September 04, 2014

Time: 6:15pm

Location: Over-the-phone

Length: 27 minutes

Interviewee (Gender): Male

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: Being outside made me want to be outside more. It made me want to observe more. I like to run so I get to see lots of natural life around. Does that make sense? I don't know that I would say one made me want to do the other or something like that. I just liked being outside.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: In 4th grade I tried to play football, but wasn't too good at it. In middle school, I started running. In high school, I kept running and then started swimming. The running was all outside. I didn't play much else, baseball, basketball.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: No, I wasn't involved in any of those things.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: I did like a lot of leadership stuff. We went to Rock Springs, near Junction City, KS. I've been there 3 or 4 times. I was a nice time out there because you get to see the stars and

everything. The sky always seemed so clear, big. It was nice to see the sky that you can't see in the city.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: Partly of financial reason, there were not a lot of vacations so that's why I liked to spend a bunch of my time outside. Being outside was like my vacation, that's how I like to kind of, a place to be free in a sense, do what I want. I never really liked to be cooped up.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: For me, I went to elementary [school] in 3 different states. Nevada was hot. If the heat was over 120, they wouldn't let kids go outside. I would probably say we spent most of our time on a playground area, half black-top, half field, for kickball. I liked being outside and being able to run around. In Nevada we were living in Las Vegas. Near the city it was probably more suburban and there wasn't really much around. We'd have to drive to other areas for nature, sometimes hours to go hiking. We would take trips to waterfalls and things like that, but lots of driving.

In Ohio, at school we would go on walks by the rivers, so I liked that a lot. I liked being around water. I learned to be cautious of certain things, but don't be afraid to try and discover things. It was first time I started fishing on my own, sort of, with my older brother. That was more a small town, but it wasn't a long walk to the river.

New Mexico we lived in the valley and then up in a town. In the valley we were surrounded by trees. There was a river about a quarter mile away. I would take walks down there along the banks. See what animals and wildlife I could see. I was really surrounded by the environment, by woods, rivers, neighbor farm animals. Ride the horses. Rode them a couple time here and there. Up north, it was a small town, more deserts. Mountains were not that far for hiking. In 5th grade, selected for field trips once a week (every Tuesday). We'd test water to see if it was contaminated, we'd go hiking, lone are we had to see if we could find arrowheads, which was pretty cool. In the town area, it was surrounded by sage brush. Not many trees at all. I learned a lot about prairie dog and saw a lot of those. Seeing natural life was pretty cool no matter where I was living.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: I'd probably say, weather. If it was like too cold. In Ohio, sometimes it would get below zero, in the negatives. I'm not a big fan of cold. I'll play in it for a little bit but then I'll go outside. I did like the rain, but my mom didn't like us playing outside because she didn't want us to get sick or anything.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: For me, one thing I really remember is back in New Mexico, on the field trips, when went hiking, there was a big trail, with friends/classmates. At a rest point, teachers let us go walk around on our own to see what we discover. I saw rapids in the river, "Oh, I see this rock in the middle and I can get to, that I can sit on." I hopped from rock to rock to get into the middle of the river which was extremely cool. But thinking about it, if I would have fell, I could have been gone. It sounds like a negative thing but it was more positive, just because, I think it's cool how the environment works, how it becomes something now, then something can change. If you add something in, it can be a negative thing. I like being on water. The power of the river, it's very cool

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: None that come to mind. Thank you.

Appendix J – Childhood Outdoor Experiences Interview Questions

Date: September 02, 2014

Time: 5:50pm

Location: Over-the-phone

Length: minutes

Interviewee (Gender): Female

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: I definitely think I learned from playing outside. I'm not sure I learned about nature specifically, but I certainly think I learned problem-solving skills in how to build something or how to get around an obstacle, over a ditch or something. I would say we were also creative. We were trying to hide in new places, build a new fort, and make up new games to keep ourselves entertained. I suppose you could say I learned about weather too. We had lots of big storms where I lived, and then when I was in Montana staying on the farm, you could see for miles and watch the clouds move.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: I mainly played basketball growing up. I tried a lot of other things, like softball and volleyball, but those never lasted very long. I think I played soccer one summer but didn't spend much time with it after that.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: No, I never did any of those things. I volunteered a lot at church, that was organized. But I didn't ever really do any of the club stuff like that. I really was always busy playing sports and just going from school to practice to home and then do it all over again the next day.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: I guess you could call my summer trips a summer camp. A family friend and I went to stay with our grandparents every summer in Montana growing up. We were there for 6 weeks or so, sometimes longer depending on the summer and our parents work schedules. It wasn't like a camp, but it was a small town in the middle of Montana with nowhere really to go. They had some property around the area and we'd just go explore those places.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: I think we mostly went to cities or places to do the tourist things. We went to Europe a couple of times, but that was really to visit family. My mom's side of the family is from there and still live over there so we had places to stay. Really though it was still touring around, not really planning to spend time outside. We traveled around the United States a fair amount, but mostly to cities, New York, Chicago. Except for my summers I don't think we ever really planned for time outside. I think we went skiing a couple of times, and hiking, but those were really vacations since we were kind of living in Montana for part of the year. I guess.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: It was very urban. Lots of diversity. Not much access to nature except for city parks or school playgrounds. There were lots of black-top areas with basketball goals, slide, swings. But not a lot of just nature spaces. We would run around the neighborhood, ride our bikes to the park and stuff. And like I said, during the summer it was totally different. I was out in big open fields. I think the town only had a couple hundred people. Only one grocery store. Not a lot to do so we were always riding bikes, running around, exploring, and making up things to do. It was very different from where I spent the school year. I really liked having both places to spend time growing up. I'm not sure you would say I'm the most outdoor loving person you'll ever meet, but I don't mind spending time outdoors. I don't really care for the bugs in the summer, but that's about it. I like swimming, but didn't swim in lakes or ponds much. It always kind of grossed me out. I just feel really lucky that I had the opportunity to get out of the city, urban environment as much as I did.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: Like I said, it was a pretty urban environment. Some people didn't feel it was the safest neighborhood in town. I was usually allowed to go to friends houses if I wanted and run around if it was within a block or so. But mostly after dark we had to stay at home and in the yard. I guess there wasn't really much that kept me from being outside except weather and my schedule. I really didn't have a lot of free time with school and sports. It was always pretty busy. Sometimes my brother and I wonder how our parents did it all the time.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: I'm not sure I could say there is just one. I think just the trips to Montana that I've talked about already really helped me understand and appreciate nature, appreciate the environment. Just being allowed to wonder around in the fields and climb up the hills to see how far you could see, you know. I think that really hit me a couple of times. Montana has these big open skies where you can see for miles and miles. It sort of just stopped to make you think sometimes.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: I can't think of anything. Interesting questions. Thank you. Good luck.

Appendix K – Childhood Outdoor Experiences Interview Questions

Date: September 07, 2014

Time: 11:30am

Location: Over-the-phone

Length: 35 minutes

Interviewee (Gender): Female

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: I don't know how to answer that. Well, if you're asking what poison ivy was, no. But I learned what bugs were, what salamanders looked like. And, I just wasn't the kind of kid who ate things, so I didn't have to worry about eating all the berries, you know? That's the other thing, I don't what trees are what, what birds are what. And I'm not allergic, I don't have allergies, hay fever, stuff like that, being outdoors. I guess my experience was limited in learning because I didn't have problems. You know what I mean? Does that make sense? Because I think if I was allergic to poison ivy, I would know what poison ivy looked like. If I was allergic to bee stings, I would pay attention to that.

Um, I wasn't really super interested in learning about the environment. Learning about trees, about birds, or I think I would have. But I loved being outside. We all played outside from the time we got home till dinner, then we would go back out until dark.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: I was non-stop. I did girl-scouts, I was outdoors, I played baseball with the boys. I did gymnastics which was inside, I swam which was inside. I did Indian Princess, a father daughter organization, and we camped, and we sold Christmas trees. We were constantly outside. We didn't cut the trees. No, actually the kids just sold ornaments and things. Um, but yeah, we were constantly outside. I don't remember ever being inside, except for maybe when it was cold, watching TV. It was summer, if it was warm enough, we were outside. We did [play

in the snow], but it was more of dad would take us sledding down to the school that had hills, so it was more of an occasion. And we would play out in the snow, but I don't remember doing as much when it was colder, than when it was not cold. We had huge snow drifts, taller than us. We did tunnels, igloos, you know little boxes, where you make bricks. But I remember more so, sprinklers, and sitting under umbrellas, the clear ones. As a little kid, you could totally sit under there and it would be like a little tent. Water balloons. That was fun. Three sisters, we were always playing.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: I mean yeah, I remember those little meetings and stuff, I remember, not so much. Things I remember were camping, campouts, like projects. And I would say, somewhere outside. A lot of service type stuff too.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: No, I had a stay at home mom, so she didn't need to find us day care, which is what I think most camps tend to be. But it was always at a girl scout camp, or Indian Princess for a week. So it wasn't like all summer long. We went on camping [trips]. Our big summer trips every year were camping with a group of ten families that had kids, from year to year. We went to the same place. We boated and camped, and campfires and stuff, and I remember we did that until the kids started getting old enough, and we moved.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: Our vacations were not vacations per se. My cousin got married in North Carolina, so we'd go to NC for the wedding, then we'd go to the beach. You know, it was like, they were always oriented toward something. Or you know, the camping we did every summer with the same group of people. We didn't go to Europe just to go to Europe, you know? It was always like we have to be there anyways, so let's do a vacation afterward. Always something.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: Definitely suburban, close to stuff. I mean houses were only 15 or 20 feet apart, like my neighborhood I'm living in now. We had a big backyard, with a big swing set, rings, we had two trees. One we weren't allowed to climb because it had power lines in it. But it was the only one we could reach. There were kids here, kids here, kids there. Our street was awesome; it was like four or five blocks long. There was a hill in the middle. We got bikes, skateboards, everything. And we'd go down the hill. Oh, one thing I do remember, when I was little and it was cold outside, dad would back out the car, we had a two-car garage. Dad would pull out the station wagon, and we'd go in circles, and do um, roller skates. He'd have the heater in the garage. And he'd be working.

We did not go places. If anything we walked. So that one park was down one side, and our school was the other way. We couldn't go there [school] by ourselves. We had to go with a parent. But parents were never outside, it was just kids all the time. You know what I mean, it wasn't like parents were out yelling, "Oh, don't go too far." You know, mom was inside doing stuff, and we were outside. If we got hurt, we'd come running. "Jason hit Kristy in the head with a rock."

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: I guess, rain probably did. I don't remember what we did on rainy days. No, like I said, I didn't, I didn't get sick from any of that stuff [poison ivy, bee stings].

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: I would say, for sure, I like the outdoors. I wouldn't say I love the outdoors. When you ask me about my childhood as a kid, I think about my backyard and constantly being back there. I really can't think of one thing. There's not one thing. I think I would have thought about that instance by now. I just remember all these little things. Being outside, I never wanted to stay inside, and play with Barbie's instead if everyone was being outside and playing, whatever, games.

We had a little mat. I'd do back handsprings across the yard.

That's the thing, currently, we still, we hang out outside, at the house. I mean, the house isn't big enough to hang out inside. If there were no bugs, I would be outside more. Bugs, I get eaten, and so take breaks inside sometimes.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: Not anything else that I can think of. That about wraps it up.

Appendix L – Childhood Outdoor Experiences Interview Questions

Date: August 31, 2014

Time: 3:40pm

Location: Over-the-phone

Length: 32 minutes

Interviewee (Gender): Female

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: I think my outdoor play as a child affected my opinion about the environment by making me appreciate it more. I remember how much fun I had exploring the woods and playing in the creek as a child, and I want my future children to have those experiences and opportunities. I think, overall, my outdoor experiences as a child really helped me come to appreciate the beauty and intrigue of the environment more.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: As a child I participated in many sports. I played soccer in the spring and fall in my early childhood. I played softball in the summer through elementary school. I played basketball in the winter starting in elementary school through middle school. I did dance and gymnastics in my early childhood. I also participated in cheerleading starting in late elementary school and going through my freshman year of high school.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: I participated in Girl Scouts all of elementary school. We had a really good leader who got our troop involved in a lot of outdoor activities: horseback riding, canoeing, camping, gardening, volunteering, etc. We also went to Girl Scout Camp in the summer.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: Other than Girl Scouts and organized sports, I did not participate in any outdoor-related programs.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: My family would go on one or two family vacations a year. That's not counting road trips to visit family during the holidays. We traveled to a variety of places, beaches, amusement parks, skiing, cruises, Yellowstone. But none of our vacations were really planned with nature in mind, except our one road trip through the Black Hills and to Yellowstone. We never were into camping, fishing, hunting, rock climbing, etc.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: I grew up in the suburbs, but childhood neighborhood, at least for most of my early childhood, was wooded with trails through the woods and a creek. Right behind my back yard was a wooded area, and there was a creek about a 2 minute walk from my house. I also lived close to both big county parks with lakes/ponds, and smaller parks with playgrounds and picnic areas.

Because we lived so close to the woods and a creek, both were basically in our back yard, my sister and I would play and explore through the areas all the time as kids. We loved to play in the creek near our house, and explore through the woods that were in our back yard. We would also take walks on the paths that ran through the woods in our neighborhood, and would play in the yard around our house a lot. My mother also stayed at home with my sister and me until we were both in school full time, so we went to zoos and parks in our area a lot.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: I really was not restricted from playing outside as a child, except by seasonal weather. I grew up in Kansas, so during the winter it was generally too cold to spend a lot of

time outside, except, of course, when it snowed. The summers would also get extremely hot and humid making it hard to be outside for very long, unless you were in a pool.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: I think playing outside and exploring the woods and creek around my house as a child really helped shape my views about the environment. I think they made me more interested and enjoy the outdoors more. I don't consider myself to be an outdoorsy person, but I do enjoy spending time outside, going on hikes through the woods, and exploring nature.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: No, I think that's it.

Appendix M – Childhood Outdoor Experiences Interview Questions

Date: September 09, 2014

Time: 2:30pm

Location: Over-the-phone

Length: 24 minutes

Interviewee (Gender): Female

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: I think it helped me, It helped me to know how much fun it was to play outside, to be outside, see nature and everything. Obviously it's not scary to be outside, it's fun to discover new things

Did one cause the other? Being outside helped me wanting to be out in the environment. Going outside and playing you know, as a child helped me to better understand. Learning more did not necessarily make me want to be outside more.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: Both outdoor and indoor sports, in soccer, softball, hockey, and dance. At that age, mainly outdoor soccer, mainly indoor ice hockey, outdoor skating.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: I was in Girl scouts, from 6 to 9 or so. Also, I was part of YMCA summer camps, and after school programs. Girl scouts, in the troop, we definitely did not focus much on outdoor. There were lots of arts and crafts. It was really kind of boring. We did go to summer camp which had more of an outdoor focus. One time I had to facilitate the going outside part of girl scouts. YMCA summer camps were a lot more outdoor and sports focused. We were always doing sports, always outside for hours upon hours every day.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: Summer hockey camps, had an indoor and outdoor focus. But it wasn't outdoorsy like, we're going to do things. More like a workout. And I already mentioned some of the YMCA camp things.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: Both. Family at that time lived in Florida so we went to Florida, to Cocoa Beach. Spent a couple days on the beach. Another year was Disney world. We went to Wisconsin Dells, kind of a little tourist place in the middle of Wisconsin. We had a cabin and we would go to the cabin almost every weekend. At the cabin, it was like boating, fishing, tubing, running around. I always hated going in the winter [Wisconsin Dells] because we couldn't go to lots of the fun water slides.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: In my home area [suburbia], it was near urban, bigger city, kind of like Lawrence is to Kansas City. But, I always had access, like 60 lakes near our home, like 10 minutes away or so. We were always going to the lakes and beaches. There were four parks in the neighborhood and we would bike and play on the playground. We also had parks that were like walking through the woods and stuff like that. There were lots of nature things to do around my home, especially. Minnesota is a really active state, so we were canoeing, and we liked to do, lots of swimming. It really was the best of both worlds, city and nature.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: If I wasn't outside, it would be either the weather [lightning I would be inside]. Rain was fine. Or if I got in trouble, my parents would tell me I couldn't go outside. Or if I had homework, I had to do that before going outside.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: I would say, hmm. I have to think of one. Well, I guess I always remember at our cabin, right when we got it, there was like this huge raspberry patch, and it was like, my mom and family members we all picking them. I was playing in them and having fun and everything, and seeing how this is so cool. This is crazy that all this good food comes from the ground, I just kept eating them. That was when I was younger, I thought that it was cool that this really good fruit came out of the ground that I wanted to plant more. But my parents wanted to tear it down. I guess that kind of shaped my thoughts toward the environment. I wish we wouldn't have torn them out.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: I don't really think so. Thank you for asking.

Appendix N – Childhood Outdoor Experiences Interview Questions

Date: September 07, 2014

Time: 1:15pm

Location: Over-the-phone

Length: 29 minutes

Interviewee (Gender): Female

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: Yes, I learned. We learned to appreciate the environment in a way that we appreciated agriculture, and farming, and what it did.

But my parents don't recycle. I didn't learn about that kind of stuff until I went to college. I appreciate the environment in a new way as an adult, than I did as a child. I think our family appreciated the outdoors, but maybe in a different way. We have hogs, and grow crops.

[On the farm] I wouldn't say our hogs are the most environmentally friendly operation. It's a large scale operation. They have barns, and compost system; they have a lagoon, where the fertilizer goes. But it's not like a friendly place; you're not walking around seeing the pigs when you're walking down the road. They're all in confined environments. They do have a nice compost system. They do it really well. You might picture the barns, you walk in, and they're all open. A bunch of pigs running around. It's all dry. They have a false floor, so all the stuff just like, falls through. They only have 8-foot pens. The pigs can move around in the pen. It's not like a confined space where there are 50 pigs in one little pen. I think people have the impression of that, when you think of a large scale operation. Ours is not like that. The pigs, we keep them safe. It's a good environment. But it is a large-scale operation, there is no way around that. 3,000 pigs. They have containment tanks, my dad is certified in compost, they know how to take care of all of that.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: We lived on a farm, kind of out in the country. We weren't far from town, but it wasn't very big and so didn't have a lot of chances for sports. It was mostly just neighbors or my sisters from time to time, playing in the yard or riding our bikes around the roads.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: I was like the only non-farm girl. I didn't do any of the FFA or 4H, or anything like that. I'm the only one [kid] that didn't stick around. You know, walking around the hog barns, I knew the past time, I would help out with the business stuff. I was the girly girl of my family. I always say I'm a farmer's daughter who's not really a farmer. And we had employees on the hog farm, we didn't work the farm at all. We had employees.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: There wasn't really much around or places to spend summer camps.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: Our vacations were around my dad, building stuff for my relatives. We would travel around to see relatives if my dad was helping them to build something, a garage or shed or something. We didn't take actual vacations or travel around just to go. I remember one trip to visit an aunt or something, down to Atlanta. Dad was helping build some furniture or something, and we went to the Olympics. We were outside a lot for that.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: The farm. We used to play outside. We used to ride our bikes, we used to play baseball, catch. We had a pony. We had a barn. We had 4 acres. We had dogs. We played kickball. There were 4 of us. And we, the next closest group of young people, was what, five miles away, so we only played with each other.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: Really just the weather. If it wasn't storming we'd be out riding around on our bikes or playing baseball, kickball or something.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: A really cool moment in my childhood was when she [sister] learned to ride her bike. The four of us could finally ride out there together. She learned really early, on a purple bike, I remember. We were outdoors a lot. We were all very close in age. Once she could ride we could all wonder around together.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: I guess going back to the recycling. We burn lots of stuff. What we can burn, gets put into a pile behind the hog barn. I remember one time, Dad came by asking if anyone wanted a chair, "Does anyone want this chair?" Then he threw it on top of the burn pit. We watched it that morning. Just sitting out on the deck, and we like watched it burn. It's like a challenge for my dad. And they don't, they recycle cans, like aluminum cans. We've always done that. Um, but anything else, they do not recycle. Even when I, I'll take home stacks of newspaper, cardboard, or something like that. But it gets too difficult, even, to grab everything they've got, when I'm only home once every three or four months. So, that's something I wish they would do. But I didn't appreciate that until I was gone. But I think my parents, I feel like we grew up appreciating the environment. From a different perspective, agriculture. We give back in that way. I think my parents give back by farming the land. Or by appreciating people who farm the land.

Appendix O – Childhood Outdoor Experiences Interview Questions

Date: September 01, 2014

Time: 4:25pm

Location: Over-the-phone

Length: 16 minutes

Interviewee (Gender): Male

Interviewer: Thank you for taking the time to complete the online portion of the Natural Experiences Scale (NES) back in May 2014. At that time you provided your name and email address to be placed into a pool of optional interview participants. You have been randomly selected to provide some additional details regarding your outdoor experiences during middle childhood (age 6 to 11). Please provide as much detail as possible.

Interviewer: How do you think your outdoor play as a child may have affected your knowledge of the environment today? [Reworded] While spending time outdoors, did you find yourself learning about the environment? Or did you find that the more you learned about the environment the more you wanted to be outside?

Interviewee: I'm not sure that it did. I was outside from time to time, especially during the summer. But it was mainly just playing in the streets or riding my bike. I didn't necessarily going exploring or anything like that.

Interviewer: Describe your participation (if any) in organized sports as a child. Did you play outdoor sports? Indoor sports?

Interviewee: I played outdoor sports, like golf and swimming. I wasn't on any teams, but still like to play.

Interviewer: Describe your level of involvement and experiences (if any) in organizations as a child (*i.e.* 4H, YMCA, Boy/Girl Scouts, etc.).

Interviewee: I was in Boy Scouts for a few years during elementary school. I don't feel like we did much so don't really remember a lot of it. I don't think we took big camping trips or anything like that. I think I would remember doing that.

Interviewer: Describe your involvement (if any) in outdoor-related nature camps or programs (*i.e.* day camps, residential camps, etc.).

Interviewee: I never went to any summer camps. I mostly just hung around home during the summers and played around the neighborhood.

Interviewer: Describe your family vacation habits (if any). Did you vacation in large cities? Or were your vacations planned with nature in mind (*i.e.* natural parks, camping, fishing/hunting, climbing, etc.)?

Interviewee: Family vacations were almost always to Orlando, FL. I think we went to Disney World four or five times. I don't really remember many other trips. Disney World was outside, but it was obviously more of a built park than just going to a national park or something like that.

Interviewer: Describe the local environment where you grew up. Did you have easy access to nature sites (*i.e.* woods, creeks/streams, open fields, etc.)? [For additional context] Describe details about [unstructured] outdoor activities you were involved in as a child (*i.e.* if you played in the woods, in what kind of activities did you participate?).

Interviewee: I grew up in suburbia. The neighborhood was still expanding so we had a field at one of the street. There was also a small pond for a while where we could fish. I usually just played on neighborhood streets.

Interviewer: Describe any reasons you might have had for a lack of time spent outdoors as a child (*i.e.* environmental hazards, distance to open spaces, safety concerns, parental permissions, etc.).

Interviewee: There wasn't really much that kept me inside except parent permission. I didn't go outside very often, but it wasn't because my parents wouldn't let me. I guess I just didn't feel like being outside, I didn't go exploring or anything like I said earlier.

Interviewer: Describe an experience you feel has shaped your views on nature and the environment (positive or negative).

Interviewee: Nature never hurt me as a child so I have a very positive view of nature. Even though I don't feel like I spent a lot of time outdoors, there wasn't anything that really made me dislike being outside.

Interviewer: Do you have any other comments or questions related to your outdoor experiences during your childhood?

Interviewee: I don't think so. Thank you.

Appendix P – Childhood Outdoor Experiences Focus Group Transcript

Date: September 10, 2014

Time: 4:30pm

Location: Face-to-face (place of employment)

Length: 60 minutes

Focus Group Members: Three females

Interviewer: Thank you for taking the time to discuss the findings of my work on the Natural Experience Scale. I'll begin just by explaining what the scale is and a brief summary of the results, then you can offer any insights you might have regarding the study.

Interviewer: The survey was given this past spring to an ungraduated introductory Biology class. There were about 725 students enrolled. Over half of the class took the online portion of the survey, 382 students. Most of those were female, about 2/3 female, and 1/3 male. Because of privacy reasons I was not allowed to get into the server system to identify the full roster to determine the gender of the class as a whole. If I were to go off a roster list and determine gender from name, there was a chance to introduce cultural bias. Therefore, this was not done. I'm not sure then if this sample is representative of the class as a whole.

Within the survey, three parts, there were basic demographics straight from the United States Census. A couple of extra questions were added to address family income without asking family income directly. For instance, the size/type of house, single-family, duplex, apartment building, etc. The second part was an environmental knowledge test. There were twenty environmental knowledge questions that were asked, based on previous research. Then twenty-six outdoor activity type items, with the intent being using the scale developed, based on previous research, that I would gain some level of outdoorsiness. So the higher score you have on that portion of the survey, the more outdoorsy you would be.

Female 1: The age range was based on the fact that they were freshman in this class?

Interviewer: The intent had to do with accessibility first of all. The other piece of that was to get as broad of sample as possible. For a liberal arts education at the university, the students needed at least one natural science course. You can take Geology, Geography, Biology, etc. The largest enrollment was in this undergraduate biology course. Those tend to be those students just taking liberal arts class, trying to get away from those students that might be science majors. And yes, most of the students in this class were freshman.

Female 1: The outdoorsiness, was that based off any other previous type of questionnaire?

Interviewer: Yes, so there is pretty substantial research in environmental attitudes, and the relationship to the environmental knowledge and behavior. But it's more about attitude about the environment and not actual outdoor activities or experiences. So what I did to develop the scale was looked for other surveys. There is the Nature Relatedness Scale. Through a factor analysis, they identified three factors, one of which was outdoor experiences, actual outdoor things that you did. I started there and generated an item pool of a wide variety of outdoor activities that you could do. I think I came up with an initial list of 75 items or so. The other basis for that was the work that Howard Gardner did on the naturalist intelligence, and different activities someone with a high level of naturalist intelligence might do. I looked at those who exhibit this type of intelligence, what were activities they might engage in. This help to develop the item pool. Through a pilot survey, I began to narrow the item list down, through inter-item correlations, concerns over normality, etc. Eventually I came up with the final twenty-six items.

Female 2: In the summary, you mention five working hypotheses. Can you give a brief explanation of each of those?

Interviewer: Sure. The first one had to do with the larger overarching question of the study. Was there a correlation between a person's level of outdoorsiness and their level of environmental knowledge? Essentially are you learning anything while playing outside? The second was both of those, environmental knowledge and outdoorsiness, and the difference in gender, were there any difference of means between to two measures based on gender? The third was about home environment during the time of middle childhood, and where you grew up. The forth one was about education and the impact of formal science education. In high school, where you have choice of the science classes you can take, did the number of science courses have an influence on environmental knowledge? This was partly determined by a multiple regression analysis that plays into the fifth hypothesis of free-choice learning. Things like taking trips to the zoo or museums. Those two kind of went hand-in-hand, the formal education and free-choice learning. The multiple regression was done to determine the best predictor of environmental knowledge: outdoorsiness, formal education, or free-choice learning. Maybe not surprisingly, it was formal education. This result was taken with some skepticism as I had some respondents indicate that they had taken 6-10 science courses while in college but were only freshman. A few of them indicated that had not taken any. College science courses were another question on top of high school courses. I had thought about whether the six to ten class folks if they were non-traditional students and could have taken more than just one biology class. Other than this being an introductory Biology class, there was no other identifying marker for age.

Female 1: Possibly they could have viewed the question as hours instead of classes?

Interviewer: That is certainly possible. Maybe for a future study ask students to identify with a given class (freshman, sophomore, etc.).

Female 1: They might have also combined the number of high school science classes with those taken in college?

Interviewer: These respondents were outliers, only having a few choose the six to ten class range. However, the way the questions was worded certainly could have created some confusion.

Female 2: Or did you throw that data out?

Interviewer: So I did check for outliers, and the few responses that I mentioned as outliers actually fell within the statistical bounds, so I did not remove them from the statistical analysis.

Female 2: Overall, generally, you mentioned the tests that you ran. What were the tests again?

Interviewer: Well, for the first one, I'll use NES for outdoorsiness, just now much were you involved in outdoor activities. The first test was a basic correlation analysis between NES and environmental knowledge. There was a statistically significant correlation, though this was pretty weak. Another suggestion I received at this point was to test for effect size. Which, for a correlation analysis, effect size and correlation are the same. This still led to a very weak correlation between the two. So yes, there is something there, statistically, it doesn't necessarily mean much.

The remaining tests were really to determine difference of means, either through independent sample t-tests or ANOVA's. The part of gender was pretty straightforward. The idea of home environment, urban, suburban, rural, or farm, was a little more difficult. One question asked the respondent to identify their zip code, based on where they primarily lived during middle childhood. With the environment, they would enter their zip code. In the case of a large city, what you interpret as suburban versus what I interpret as suburban could be different, regardless of zip code. I mapped all the zip code responses, and in the case of Kansas City, for example, one zip code would be identified as urban and suburban. So the results within the case of home environment may be a little skewed just based on definition.

Female 2: But you didn't decide to make a call? Just pick urban for one zip code? Or suburban?

Female 3: And I wonder, how current is your map? So the students who lived there as junior high kids, you might go back and pull a map, maybe it used to be rural, or suburban and now has changed with development.

Female 2: I'm almost wondering too, how environmentally conscious some suburbs are? How can being outdoorsy combine with just local concern over issues? I know places like Chicago and surrounding areas are very environmental. Something like that can vary from county to county, or city to city in smaller municipal areas.

Female 1: Now I'm even thinking about schools. Whatever school they went to, they reflect the community. Could they have had environmental science classes? Maybe the department of education might store past curriculum where you could look at what local schools used to teach. But then you also have individual teachers that might pull in things like this that are areas of interest or concern to the teacher. Maybe even go larger than school or district and look at what was happening in a state rather than a local, smaller district. I'm not sure if there is a way to compare what a state curriculum was, say 10 years ago, to what it is now and see if they used to include more environmental components. Just some thoughts. I think it would be interesting.

Interviewer: That is an interesting thought. I'm not sure where I could go and find all that at a local level. I know that going back 10 years or so to when this sample group was in elementary school, the National Science Standards had been adopted in 1996, and this timeframe is well within those years. Now each state was able to make changes, but generally they were in line with the national standards, for the most part. I did also collect data on elementary and middle school science but ended up throwing it out because of the lack of choice. In elementary and middle school, you had to take science, if it was being taught anyway. In high school, a person could choose to only take the minimum number of classes, three in Kansas. Or they could choose to take more. Middle school didn't have that choice.

Female 2: Getting data like that could also just help out with how a zip code might align with a given environment like rural, since I think districts identify themselves as one of those, for funding or other state guidelines.

Female 1: What about looking at things like FFA?

Interviewer: I did. That was one of the NES items about whether the respondents participated in organizations but did not mention FFA specifically. There was an interview question that asked people what organizations and involvement they had outside of the normal school day.

Female 3: Yeah, and maybe they didn't mention FFA because usually you started out in something like 4H and then went to FFA. 4H would have been more of the age range you were asking about. And 4H is different in rural and farm areas than it is in suburban or urban areas. I'm not sure what urban areas have it.

Female 1: Yeah, and the same thing with Girl Scouts and Boy Scouts.

Female 2: So, the questions on the environmental knowledge, what level of knowledge was that based on? Was that based on what a freshman would know, freshman in college?

Interviewer: Initially what happened was there were two pilot surveys, and then the final survey. Because I was looking at a degree in geography, I need to ask some geography questions, so I went straight to the NAEP (National Assessment for Educational Progress) tests, given nationally, at the 4th, 8th, and 12th grade level. Because I wanted to hit middle of the road, I went 8th grade, and in the three levels, easy, medium, and hard. I went with easy. What I noticed was that most of the questions, though they were geography questions, weren't really getting at the environmental knowledge piece I was after. They were much more place-name geography based questions, like what are the coordinates of some location of a star on a map. Through the literature review on past environmental knowledge tests, there were lots of tests from various states trying to figure out what citizens knew. There was also a national test conducted in the late 1990s to the early 2000s. However, in the literature review, it was noted a few times that all these data points are great, but if they're not measuring the same things, then how can we get a sense of what people actually know? What are the commonalities? Questions were ultimately pulled from previous national tests to use questions where data already existed. I never was able to find out what grade level the national questions were written for. The questions were very broad in nature to avoid any geographical bias. Rivers for example, someone that lived near a river might have more knowledge of the river at a local level rather than rivers on a system level.

Female 1: What's interesting, what about someone that didn't choose to go beyond additional classes, would someone just playing outside be able to answer these questions? Because what you found was that the answers related more to the schooling it seems that the outdoor activities.

Female 3: So let me think about this, if they weren't able to answer the question, then there wasn't enough interest for them to pursue that education? And were they outdoorsy? Could they answer the questions, if they were interested in the topic? And if I had spent time outside, and if that triggered interest, then I would be able to answer 10th grade questions?

Female 1: My grandpa was the most outdoorsy person I know but he couldn't answer a 10th grade question. He knew a lot about it, but he may not know about it in the right words, or the right vernacular. People have their own versions of what a fish is called; it doesn't mean they were interested; they just didn't pursue it academically.

Female 3: Right, so maybe that's why there was the highest level of significance with the courses was due to the nature of the questions. So maybe if the questions were more application based?

Female 2: I think it would be difficult to bring that element in without having a population studied that wasn't in college. Maybe a control group that wasn't in college? Obviously her grandpa was outdoorsy but he didn't go the college avenue, so you're missing a whole population that may have really strong ties, due to that positive experience [outdoors], but didn't have the formal education. There would be differences.

Female 1: Or even who they learned it from. Was hunting or fishing, and all that, they don't always learn formally. Or the right way?

Interviewer: That was some of the other discussion that was had about how do you test for this. Do you assess at the 10th grade level or does it go more application, big picture? A couple of these questions came from a study back in the 1970s by Maloney, he points out exactly that, where do you draw the line in getting very technical. That was one of my points, I knew this was difficult and at least wanted to use previous research questions from somewhere.

Female 2: This could be compared to his stuff too.

Interviewer: Right. Like if I tried to create my own scale, and my own knowledge assessment, that could be an entire career.

Female 1: Right, and that's part of the point is to see what else is out there and see if it can be validated.

Female 2: So how do you justify that you are looking at positive outdoor experiences in the age group of 6 – 11 but you test on a higher level? Because your 8th or 10th graders aren't in the same age bracket?

Interviewer: So you're saying, say in the instance of NAEP, I could have actually gone down to the 4th grade level?

Female 2: Maybe, because that's the age group that you were interested in for outdoor experiences.

Interviewer: I can see that. Except that the overall title of the study was the relationship between middle childhood outdoor experiences and knowledge of the environment as an adult. I wasn't necessarily interested in their 4th grade knowledge. I wanted to see if there was any correlation to knowledge as an adult. But this would be an interesting future research piece for sure. I can already tell my discussion chapter is just getting longer and longer.

Female 1: OK, I have another one then. What a lot of people might want to know is do these experiences cause you to act, environmentally.

Interviewer: There is some research around that very question. However, I purposefully chose not to go there at this stage. It sort of goes back to where you draw the line. Only because where do you say enough is enough. One thing that pushed me into the direction of outdoor experiences and knowledge is that there is a fair amount of information about the model referred to as the KAB model, or knowledge, attitude, and behavior. And is there a connection between your knowledge of the environment and your behavior or attitude toward the environment.

Female 2: OK, so it does say middle childhood, age 6 – 11. Not only did the questions come out of that branch, but you were also talking about the choice of classes in high school. So again, that scales it more toward the later years. Or perhaps, the entire childhood, which technically, our society takes that up to 18 years old. Maybe the focus was really broader on childhood?

Interviewer: Right, because how do you differentiate, say, on the day I turn 12, I stop paying attention to some things and not others. Or trying to remember exactly when a certain event happened? I see what you're saying. How do you stop the recall of those experiences?

Female 2: When you're in high school, you might be applying more of the academic knowledge of the environment, but you still have something that you're basing it off of.

Female 3: Also, did you happen to run, any comparisons between experiences that they had between 6 and 11, and those who chose to take the additional courses in high school? It seems that if students have greater experiences then they would have self-selected additional science courses in high school?

Female 1: See, I'm just thinking back to my high school, and those hunting and fishing boys didn't necessarily continue on with more science courses, but they knew a lot about just being outside.

Interviewer: OK, I found that there was a significant difference in mean environmental knowledge score between groups that took 1-3 classes from those that took 4 or more. So those that took 4 or more science classes scored significantly higher on environmental knowledge.

Female 3: OK, and that makes sense to me.

Interviewer: Which sort of validates that education is more a predictor of environmental knowledge.

Female 3: But what we don't know is what drove them to take those additional courses.

Interviewer: Right, but that was one of the interview questions, or something like that. But I would have only gotten that information from those 15 people that in interviewed, not from the full sample. The question being “did you being outside and your interest in the outdoors entice you to take more science classes or because you had more science did you want to spend more time outdoors?”

Female 2: Right, and there a lot of other reasons you take classes too, maybe that’s all that was available, or you liked the teacher, or a girl. You just never know.

Female 1: Did you evaluate any of the environmental knowledge questions for misconceptions? That’s one of the big issues with all of science, those issues of common misconceptions.

Interviewer: I did not address them specifically. The questions were multiple choice, and there were four choices. And they did have a ‘Don’t Know’ option for each question. In previous research, they had done a misconception analysis, looking at what misconceptions individuals had based on current events in the news. One of the four answer choices in those studies was a common misconception, looking at how often an individual selected the correct response versus the misconception. I did not select all of those questions, and so not all 20 questions were phrased in such a way as to accurately address environmental knowledge in this way. About the don’t know option, however, there wasn’t anything in the literature addressing why this was a viable answer choice. I included this as a choice based on my usage of prior environmental knowledge assessments.

Female 1: I can tell you I had that on my survey as well, and for me it was primarily, I didn’t want them to guess and happen to guess the correct answer, so it was an option. Maybe they were thinking it was more than one, or none of the response choices. Then they could just answer I Don’t Know. I put that response as another category of wrong answers, or the bulk of wrong answers.

Interviewer: That makes sense. That’s how I handled my responses as well. I was just curious how this is usually handled from study to study. When I broke out the item analysis for each individual question, I don’t think there was a single question that had more than 12 ‘Don’t Know’ responses, and out of 382, what do you do with 12?

Female 3: Not much, that sounds about right. That’s really good.

Female 1: But it can get a little frustrating because you wonder, “were they leaning toward one answer or another?” Or something like that.

Female 2: I do think the idea of misconceptions is interesting.

Interviewer: That would actually make for a good piece of the discussion section, that past assessments did look at that idea, but since I pulled from multiple surveys, I couldn't necessarily address misconceptions head on.

Female 3: Yeah, that is hard when you try to combine instruments like that. To try and take the best parts of all of them.

Interviewer: I suppose I could have just used one of the previous knowledge assessments. However, they were shorter and I didn't feel like they were totally getting at the overall idea of environmental knowledge that I was going for. So I personally selected a few questions from each of the three surveys I felt best represented the type of knowledge I was interested in.

Female 3: Something that might be worth considering in the future would be to take just the misconception questions and run those separately to see if you got any sort of different result. Would there fewer misconceptions among those individuals with a higher outdoorsiness score?

Female 1: Yeah, it would be interesting to see if those who didn't take more science had more misconceptions. And if outdoorsiness in the environment you grew up in. But you may also end of finding that there isn't a significant difference between any of those groups too. I did that with my research and didn't find anything different so it ended up being a moot point. There wasn't enough there to really analyze. There were differences, but since there weren't enough options, there wasn't really enough data to gather much.

Interviewer: I like the idea, and maybe that is a whole other study by itself. Maybe not a full dissertation, but at least a smaller study with a focus just on misconceptions.

Female 2: And then it might be interested in testing your science majors against your non-majors as well.

Interviewer: These are all great ideas. I think that's been one of the great things about just talking about this, doing the interviews, and talking with you all, you really bring on the context of the quantitative data and give it some meaning. And when picking this topic I was also told to make sure it was something I really love because in the end you may be sick of it. I think the passion for this has actually increased through all of this. I'm actually in a really good position professionally as well to use this information to advocate for some change. It feels good! I have more questions about this stuff now too, having gone through this process. It's definitely a passion not just an interest. I really want to figure out what our students need in an urban setting related to their environments.

Female 3: I certainly think you have a good audience and plenty of directions for future research. This is obviously very relevant. And all very interesting. Thank you for sharing. Was there anything else that you needed?

Interviewer: This has all been very insightful and helpful. Thank you very much for your time in discussing this project!